

TECHNICAL CONDITIONS OF CONTRACT (TCC)

**“Design, Supply and Expert Supervision for
installation works of Borosilicate Glass Block
Lining including Wet Stack Flow Model Study
for 2 X 500 MW NTPL FGD”**

**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR SOUTHERN REGION**



2 X 500 MW NTPL FGD – ADDITIONAL RCC CHIMNEY (150M HEIGHT)

DESIGN AND SUPPLY OF BOROSILICATE GLASS BLOCK LINING SYSTEM, EXPERT SUPERVISION FOR
INSTALLATION WORKS OF LINING WORKS IN CHIMNEY/ DUCT AND WET STACK FLOW MODEL

STUDY - **TECHNICAL CONDITIONS OF CONTRACT (TCC)**

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1. PROJECT INFORMATION

BHEL is executing Construction of One Additional RCC Chimney of 150 m Height Bi-flue can arrangement for Flue Gas Desulphurisation Plant (FGD) of existing 2 x 500 MW Coal based Thermal power station at Tuticorin, Tamilnadu, India, for NLC TAMILNADU POWER LIMITED (NTPL). The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

S. No	Description	Details
1	Name of the Project	Construction of One Additional RCC Chimney of 150 m Height Bi-flue can arrangement for Flue Gas Desulphurisation Plant (FGD) of existing 2 x 500 MW Coal based Thermal power station
2	Station Capacity	2X500 MW (Coal based)
3	Owner	NLC TAMILNADU POWER LIMITED (NTPL)
4	Site Location	At Tuticorin taluk in Tuticorin district in the southern part of Tamilnadu along the Bay of Munnar, India The site is accessed by National highway no. 7A adjacent to plant. Due south connecting Madurai. Tuticorin sea port is located adjacent to the plant. Nearest town Tuticorin is located 5.5 km away from the plant and nearest city Pallayamkottai is 60km away from the plant.
5	Latitude	8° 45'38.09 N
6	Longitude	79° 10'15.85 E
7	Nearest Town	5.5 Km Tuticorin
8	Nearest Railway Station	1.0 Km Port trust railway yard
9	Nearest Airstrip	16.5 Kms (Pudukottai)
10	Site Conditions	
	Ambient Temperature	
	Daily minimum (average)	20.8°C

S. No	Description	Details
	Daily maximum (average)	36.5°C
	Design Ambient Temperature	50°C
	Ambient temperature (performance)	27°C
	Relative Humidity for design / efficiency	35-82 %
	Annual rainfall, mm	437 mm
	Plant Elevation above MSL	1.46 m above MSL
	Mean Wind Speed	50 m/s
	Wind Pressure	As per the latest revision of IS 875/1987
	Seismic co-efficient	Zone-II as per IS- 1893 (Part-IV)

The bidder is advised to visit and examine the site of works and its surroundings and obtain for himself on his own responsibility all information that may be necessary for preparing the bid and entering into the contract. The bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions, soil strata and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may have not been specifically brought out in the specifications. All costs for and associated with site visits shall be borne by the bidder.

2. BROAD SCOPE OF WORK

Scope of tender covers "Design, Manufacturing, Supply of Borosilicate lining system and Expert Supervision for installation works of Borosilicate Glass Block Lining for 150 mtr tall twin steel flue RCC chimney at 2 x 500 MW NTPL, Tuticorin. Following are the broad scope of work for reference.

- 2.1 Design, Manufacturing & Supply of Borosilicate lining system include supply of Borosilicate glass blocks, adhesive membrane and primer.
- 2.2 Supply of automated mixing machine(s) for mixing of adhesive membrane and Mechanical mixers for mixing of Primer

- 2.3 On-site technical support and QA/QC supervision by the supplier during surface preparation of substrate, application of primer, mixing of two components adhesive membrane, application of adhesive membrane and installation of borosilicate glass blocks, etc. The supplier shall employ QA/QC supervisors with a demonstrated experience of at least 5 years in technical support and QA/QC supervision of the subject lining system.
- 2.4 The Manufacturer/ supplier shall also provide ten (10) year full replacement guarantee for the system, and bear the cost of replacement, supply, installation all complete, if the lining system deteriorates or fails to protect the chimney flue liner.
- 2.5 Conducting Wet Stack Flow Model Study as per Technical Specification.

3. DETAILED SCOPE OF WORK

The scope of work includes but not limited to design, engineering, supply of material and services required for completion of the work scope as follows:

- 3.1 Design, Manufacturing & Supply of Borosilicate Glass Block Lining system consisting of minimum 51 mm thick closed cell borosilicate glass block lining material confirming to physical & chemical properties mentioned in technical specifications, handling, storage & transportation up to CIF Tuticorin (for foreign bidders) /FOR Site (for Indigenous bidder) including required epoxy primer and adhesive membranes, Mixing Machine, Special tools/tackles and any other T&P etc. for application of borosilicate glass block lining over mild steel flue liners with adequate packing should be completed in all respects within the specified time schedule. It is bidder's responsibility to assess and supply all the material required for completion of specified scope taking into account wastages/normal loss/spoilages etc. unless otherwise stated.
- 3.2 Scope of work include supply of Borosilicate glass block lining system for flue gas duct upto Chimney inlet flange (incl. transition duct) and chimney steel flue cans as per Specifications.
- 3.3 The area in square meter indicated in BOQ cum Rate Schedule for application of borosilicate glass block lining system is tentative and may vary in case of change in design/ application requirements. In case of any increase/ decrease in the area in square meters the same shall be intimated before supply of borosilicate glass block, adhesives, membranes and primer etc. and the Lump Sum Price quoted shall be adjusted in proportion to the decrease/ increase in the surface area. However, the prorata rate worked out for per square meter surface area shall be firm. The Adjustment in price of BOQ item no. 1 of BOQ cum Rate Schedule shall be made after

deducting the price of Mixing Machine and Special T&P /Tools/Tackles (If any). The price of Mixing Machine and Special T&P/ Tools/ Tackles shall be considered as 0.5% of the total cost of BOQ item no. 1 for payment purpose.

- 3.4 The Bidder shall provide details of total quantities of borosilicate glass block, adhesives, membranes and primer required for installation of borosilicate glass block lining over the indicated surface area of the chimney (as per details furnished in tender specifications/ subsequent variations, if any) according to their detailed engineering. The Bidder shall submit the Billing Break-up (BBU) indicating the total quantities and Unit of Measurement for the indicated surface area for approval of BHEL. The Bidder shall also intimate the per square meter quantities of borosilicate glass blocks, adhesive membranes and primer required for application as per specifications.
- 3.5 In case of any increase/ decrease in the quantities for the specified area, the bidder shall be responsible for its supply without any price implication within the indicated supply schedule.
- 3.6 The Manufacturer/ supplier shall also provide ten (10) year full replacement guarantee for the system, and bear the complete cost of replacement including the cost of material supply, installation with full-time onsite QA supervision, all complete, if the lining system deteriorates or fails to protect the chimney flue liner and duct from internal deterioration as per specification.
- 3.7 **Conducting Wet Stack Flow Model Study**
The Bidder is required to carry out the Wet stack flow model study of Project as per Technical Specification, Preparation of final report and recommendations, preparation of drawings/ documents for execution of collection system, obtaining approval on documents from BHEL/ Customer/ Customer's consultant, Preparation of BOQ, preparation of bought out item specification, procurement assistance for specialized items, site visit as specified later in the specification & as necessary for completeness in all respects and for efficient & trouble free operation of chimney and liquid collection system for project as per the Technical Specification for Wet Stack Flow Model Study.
- 3.8 Supply of special T&Ps exclusively required for installation of Borosilicate Glass Block lining system shall also be in the scope of supplier.

- 3.8.1 Mixing Machine: In order to ensure consistent, high quality mixing of the components of the lining system adhesive, (an) automated mixing machine(s) shall be provided with 3,200 W mixer motor with fail-safe protection against the operator error of mixing the main adhesive component without its hardener. The mixing machine must be CE – approved. The mixing machine shall have thermal motor protection to minimize failure and fire risk. Adequate number of mixing machines shall be employed for completion of the installation works for the two units/flue cans within the scheduled time.
- 3.8.2 Bidder shall provide all special equipment, tools and instruments required for handling and storage, and for test and maintenance of borosilicate lining system provided under this Contract. Any special tools/ tackles, machinery/ equipment required to maintain the controlled environment (temperature, humidity, etc.) during installation of borosilicate glass block shall be in the scope of bidder.
- 3.8.3 The Supply of Mixing machine, special tools/ tackles etc. shall also be completed along with Borosilicate Glass Block Lining materials in line with the Time schedule in Clause No. 8 of TCC. Two-year Guarantee/ Warranty from the date of commissioning of mixing machine shall be bidder's responsibility. All spares (if any) required during the Guarantee/ Warranty period shall be in scope supply of bidder.
- 3.9 No extra payment shall be made for special T&Ps required for application of borosilicate glass block lining system over mild steel flue liners and flue gas duct.
- 3.10 During the application of the Borosilicate Lining system, the successful bidder who is supplying the Borosilicate Lining system shall also supply sufficient number of skilled supervisors to assist the Application of the Borosilicate Lining system. A separate QA plan towards this shall be furnished before starting of the works by the supplier for the approval of the owner.
- 3.11 Contractor shall get installation procedure approved by BHEL before installation including verification of installation procedure & workmanship standards of the lining system.
- 3.12 **EXPERT SUPERVISION**

The scope of work with respect to Expert supervision shall include the following.

- a. Full-time onsite QA Expert Supervision and technical support shall be provided by bidder during Installation of Borosilicate glass block lining system inside MS flue cans and flue duct. The Bidder shall demonstrate the application methodology to the BHEL/ NTPL and BHEL's Installation/ erection agency with a view to ensure its installation as per the specifications and guaranteed parameters. The surface preparation, application of Primer, mixing of two components adhesive membrane by automatic mixing machine etc., application of adhesive membrane and installation of Borosilicate Glass Blocks, etc. all complete shall be executed by erection agency of BHEL under the expert supervision of Supplier.
- b. Supply of special tools requirements before commencement of work must be ensured by Supplier.
- c. Any defect/ non-conformity which may have potential impact on the guaranteed parameters shall be pointed out and cleared by the supervising experts after rectification by the erection agency. Once, the borosilicate glass block lining is installed under the supervision of the Experts deputed by the Supplier and protocol of completion of installation is jointly signed, Supplier shall be under obligation of Guarantee in line with Clause No. 21 of TCC.
- d. Number of supervisors to be deployed and period of deployment should be as per site requirement duly agreed with BHEL.
- e. Supervisory personnel shall co-operate with other agencies at site and co-ordinate in association with BHEL and customer's engineers at site. Supervisory personnel shall follow the Health, Safety and Environment (HSE) regulations in force at project site under the scope of supplier.
- f. All travelling expenses/ Visa fees / Medical fees to be borne by bidder. Boarding & Lodging to be borne by Bidder.
- g. Medical: Supplier to arrange for medical insurance coverage for their representative. All medical expenditure shall be to the account of Supplier.
- h. Working Hours: As per local BHEL site requirements. Normal working shall be 06 days per week. For Supervision Work: No overtime payment/ charges is payable. The Man

days for payment purpose shall be calculated from the day when bidder reports at site for commencement of borosilicate execution work.

- i. Deployment Schedule: Deployment needs to be planned in phased manner depending upon the progress at site. The schedule of execution of work for required supervision services shall be intimated by BHEL. Further review meetings shall be held at site to discuss work progress and deployment program.
- j. Personnel deputed to site shall be an expert in their field and responsible for direct supervision/ execution of field activities. They should be able to interact with their parent division at their HQ for trouble shooting operations/ Engg. Clarifications etc.
- k. Visits as indicated shall be required for deputation. Expert to complete assignment for each phase/ visit as per BHEL's requirement. In case of site non-readiness/ mutual agreement with construction manager/ BHEL site, the deputation programme shall be mutually discussed and agreed upon.
- l. Supplier to submit their check list with detailed activity network with recommended manpower along with general tool and plants needed for site readiness for deputation of their personnel.
- m. Project Management meetings shall take place at BHEL PSSR site office before start of deputation and during course of execution (as per requirement). Responsible representatives from Supplier shall attend these meetings on BHEL's call.
- n. Protocols for application/ erection of Borosilicate glass block lining system shall be signed by Supplier's representative at BHEL site.
- o. Supplier's representative at site shall be under the administrative control of Construction Manager /BHEL site.
- p. Supplier representative at site shall co-ordinate for their materials availability at site/ report shortage/ discrepancies of materials and associate himself for coordination/ compressing of application/ erection of Borosilicate schedule as required by BHEL site.
- q. All out efforts are to be made by both parties to complete site works within the most reasonable time/ earliest possible.

- r. The Man days for payment purpose shall be calculated from the day when Supplier representatives/ Supervisory Personnel reports at site for commencement of borosilicate blocks execution work with the time sheet certified by BHEL Engineer in charge for actual number of man-days utilized and satisfactory completion of works at site.
- s. Payment shall be made for visit of vendor representative as per the time sheet certified by BHEL Engineer. Payment shall be released by BHEL on monthly basis against invoices raised by Supplier to BHEL site with certified time sheets.
- t. Under force majeure conditions applicable to BHEL engineers, supplier's experts are to be repatriated by supplier at his own cost.
- u. All Miscellaneous Expenses required by Supplier's representative at site are to be borne by the Supplier himself.
- v. Rates quoted/ agreed shall remain firm till the completion of contract and shall not be subject to any price variation.
- w. Expected period of supervision required for application/ erection of Borosilicate glass block lining system shall be as per BOQ cum Rate Schedule S.no.2. However, the payment shall be as per the actual deployment of Supervisory personnel at site based on mutually agreed programme.

4. BOQ CUM RATE SCHEDULE

- 4.1 The work under this contract shall be carried out as per BOQ Cum Rate Schedule attached. The description/ specifications as per BOQ (Bill of Quantities) shall be read along with technical specifications. Quantities mentioned in the BOQ cum Rate schedule are approximate only and liable for variation due to change/ variation in schedule of quantities, changes in design etc.
- 4.2 The rate quoted by the bidder for the individual item of BOQs shall remain firm irrespective of any variation in quantities. The bidder shall undertake to execute actual quantities required for completion of works as per instruction of BHEL Engineer and accordingly the final contract value shall be worked out on the basis of quantities actually executed and payments will also be regulated for the same. The quantities indicated against each item may vary to any extent and no compensation will be payable in variation of Individual quantity.

- 4.3 Any activity which is necessarily required for satisfactory execution of any item of BOQ in line with technical specifications shall be deemed to be included in BOQ item even if it is not described in the item description and no extra payment shall be made against such activity.

5. PRICE

5.1 A. INDIGENOUS BIDDERS

Bids of Indigenous Bidders shall be in Indian Rupee only on FOR destination site basis (Indigenous Bidders shall quote the rate excluding GST, GST cess and TCS, if any).

B. FOREIGN BIDDERS

Foreign bidders to quote in USD only on CIF (Cost, Insurance & Freight) basis (Port-Tuticorin). For CIF Tuticorin delivery, Insurance (Inland) and Transportation (Inland) shall be in BHEL scope. However, FOR destination site price for foreign bidder will be calculated by loading their CIF (Port-Tuticorin) price up to site as per Clause No. 6 of TCC.

- 5.2 For importing materials on CIF basis, bidders to note that the Freight is to be quoted as inclusive in Basic price by vendor and is not to be quoted separately.
- 5.3 Bids of Indian supplier shall be in Indian Rupee only and on FOR basis.
- 5.4 Bids of foreign suppliers shall be in USD and on CIF basis.

6. PRICE EVALUATION

- 6.1 Conditional offers will not be considered.
- 6.2 Tenders will be evaluated on the basis of total cost taken into consideration loadings, if any, and all available financial advantages, including those available from Owner, taxation authorities etc.
- 6.3 For evaluation, exchange rate (TT selling rate of State Bank of India) as on date of tender opening shall be considered. If the relevant day happens to be a bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.
- 6.4 In case of foreign bidders, the quoted CIF price shall be loaded by following factors to arrive at total FOR Site price:
- a) For loading towards Custom Duty, suitable clause to be obtained by Purchase from Finance.
 - b) Port handling/ clearing charges – @ 1% of CIF value.
 - c) Inland freight- @0.5% of CIF value.
 - d) LC Payment - @ 1.5% of CIF value.

7. VARIATION OF CONTRACT VALUE

- 7.1 Rates against each line item of the BOQ cum Rate Schedule shall remain Firm for any increase or decrease in the BOQ quantity.
- 7.2 This tender is a Firm price contract and Price Variation is not applicable.

8. TIME SCHEDULE

8.1 MATERIAL SUPPLY

Tentative Delivery Schedule for supply of material for the Project shall be as follows.

S. no.	Project Name	No. of chimneys	Tentative Delivery Schedule	Lining Installation Schedule
1	NTPL Addl. RCC Chimney	1	AS PER SCHEDULE GIVEN BELOW	AS PER SCHEDULE GIVEN BELOW

For Foreign Bidder:

S. no.	Activity	Agency responsible	Duration
1	Manufacturing clearance	BHEL	0 day
2	Submission of Manufacturing test Certificate (MTC)	Bidder	3 Months
3	Issuance of MDCC	BHEL	1 Week
4	Generation of bill of lading	Bidder	1 Month
5	Receipt at Indian Port	Bidder	1 Month
	Total Duration		5 Months 1 week

The date of Receipt of goods at Indian Port **shall be considered for levying LD in line with the provisions of GCC**. The shipping company's intimation regarding arrival of ship at destination port shall be considered the date of receipt of goods at Indian port.

For Indigenous Bidder:

There are two Categories in which the Bidders may be categorised based on whether the material is imported or supplied from works in India

Category 1 - material is imported by Bidder.

Category 2 - material is supplied by Bidder from Works in India.

S. no.	Activity	Agency responsible	Duration	
			Category -1	Category -2
1	Manufacturing clearance	BHEL	0 day	0 day
2	Submission of Manufacturing test Certificate (MTC)	Bidder	3 Months	3 Months
3	Issuance of MDCC	BHEL	1 Week	1 Week
4	Despatch of material (4a or 4b as applicable)			
4a	Generation of bill of lading (applicable if material is imported by Bidder)	Bidder	1 Month from s.no.3	
4b	Despatch of Material from Suppliers' works in India (applicable if material is supplied by Bidder from Works in India)	Bidder		1 Month from s.no.3
5	Receipt at Indian Port (applicable if material is imported by Bidder)	Bidder	1 Month from s.no.4a	
6	Receipt at Site (6a or 6b as applicable)			
6a	Receipt at Site (applicable if material is imported by Bidder)	Bidder	2 weeks from s.no.5	
6b	Receipt at Site (applicable if material is supplied by Bidder from Works in India)	Bidder		2 weeks from s.no.4b
	Total Duration		5 Months 3 weeks	4 Months 3 weeks

The date of Receipt at Site shall be considered for levying LD in line with the provisions of GCC. The bidder to indicate in his offer whether he proposes to supply material through Category I or II. Accordingly, the above schedule will apply. Bidder to note that all documents regarding the origin of material, whether the material is imported or manufactured in India or supplied from warehouse of supplier in India, etc. as required by BHEL for confirming the category in which the Indigenous bidder falls and

hence to arrive at Schedule against which LD is to be levied, if leviable should be provided by the Supplier.

8.2 **EXPERT SUPERVISION FOR INSTALLATION OF BOROSILICATE GLASS BLOCK LINING**

The Schedule of supervision works shall be intimated by BHEL Construction Manager separately, in advance as per actual site requirement. **Bidder/Seller shall arrange for deputation of supervisors within 2 weeks of BHEL intimation.** Adequate number of supervisors shall be deployed by bidder at a time to meet the requirement for supervision of installation works of borosilicate glass block lining at Site. The work under the scope of this contract is deemed to be completed in all respects, only when all the works are carried out as per satisfaction of BHEL. The decision of BHEL on completion date shall be final and binding on the contractor. In order to meet above schedule in general, and any other intermediate targets set, to meet customer/project schedule requirements, bidder shall arrange & augment all necessary resources from time to time on the instructions of BHEL without any extra cost to BHEL.

9. **HANDLING, STORAGE AND PROTECTION**

Bidder shall furnish guidelines and supervision to BHEL's Installation agency during handling and storage.

10. **TRANSIT INSURANCE**

10.1 Indigenous Bidders

Inland Transit insurance from supplier's works/ warehouse in India/ from the Port of Entry to BHEL site stores shall be arranged by BHEL. Supplier to provide advance information regarding the dispatch plan for suitably arranging inland transit insurance by BHEL. Upon dispatch of material supplier has to immediately intimate underwriter of BHEL, failing which transit loss, if any, would be borne by supplier.

10.2 Foreign Bidders

For CIF Tuticorin delivery, only Inland Transit Insurance shall be in BHEL scope. Supplier to provide advance information regarding the dispatch plan for suitably arranging inland transit insurance by BHEL. Upon dispatch of material supplier has to immediately intimate underwriter of BHEL, failing which transit loss, if any, would be borne by supplier.

In both the above cases, the Bidder shall submit all necessary documents required by BHEL/ Underwriter/ Surveyor, etc. during the entire process of settlement of Insurance claim.

11. **INSPECTION**

The Customer/ Consultant and "BHEL" may depute their representative for checking and supervision of important stages of work. The bidder shall be required to provide all facilities, tools etc. as required, for inspection of works at no extra cost to BHEL. Any defect in quality of work or deviations from drawings/ specifications pointed out during such inspection shall be made good by the bidder in the same way as if pointed out by the BHEL Engineer, without any cost implication to BHEL.

12. MATERIAL DESPATCH CLEARANCE CERTIFICATE

Bidder shall intimate BHEL after readiness of 100% material at their works along with Manufacturing Test Certificate/ Warranty Certificate. BHEL will issue MDCC (Material Despatch Clearance Certificate) based on the Manufacturing Test Certificates. The Bidder (Foreign / Indigenous) shall dispatch the Borosilicate Glass Block lining materials only after issuance of Material Dispatch Clearance Certificate (MDCC) by BHEL. However, there shall not be any payment towards dispatch of materials.

MDCC shall be issued by BHEL within one month of submission of Material Test Certificate. No material shall be dispatched by supplier unless and until Material Dispatch Clearance Certificate (MDCC) is issued by BHEL.

13. WASTAGE

The Supplier to take care of Wastage during Transit, Handling & Storage at site and during application. The Supplier should supervise and control the wastage effectively. The payment shall be effected only for the installed quantity as per the Method of measurement in Clause no. 14.5 of TCC.

14. PAYMENT

14.1 The Bidder shall submit the Billing Break-up (BBU) indicating the total quantities and Unit of Measurement for the indicated surface area for approval of BHEL. The Bidder shall also intimate the per square meter quantities of borosilicate glass blocks, adhesive membranes and primer required for application as per specifications.

14.2 The payment for supplies as per approved Billing Break-up shall be released on prorata basis for the actual quantities of borosilicate glass blocks, adhesive membranes and primer supplied by the bidder limited to the lump sum price for the specified surface area after considering any subsequent changes. All the required quantities of the BOQ item indicated at Sl.no.1 of BOQ cum Rate Schedule for completion of installation of borosilicate glass block lining for the surface area as per specifications /revised specifications shall form part of the lump sum quoted price and

no extra financial implication for any increase/ decrease in BBU quantities shall be admissible for payment.

- 14.3 In case of any increase/ decrease in the quantities for the specified area, the bidder shall be responsible for its supply without any price implication within the indicated supply schedule.
- 14.4 The unit rates for various items shall include all the stipulations mentioned in technical specifications for the particular BOQ item and nothing extra over BOQ rates shall be payable.
- 14.5 Method of Measurement - Area of Borosilicate Glass Block Lining system in Chimney Flue liner for payment shall be calculated by multiplying the height of Mild Steel Flue can or Mini Shell (as applicable) over which the Borosilicate Glass Block Lining system is to be installed with inner perimeter of Mild Steel Flue can or Mini Shell (as applicable). Area of Borosilicate Glass Block Lining system in Transition duct for payment shall be calculated by calculating the actual area over which the Borosilicate Glass Block Lining system is to be installed.

15. TERMS OF PAYMENT - refer clause 6.0 of SCC for payment terms.

16. FACILITIES AT SITE

- 16.1 Storage of Borosilicate Glass Blocks, Primer and Adhesives are in the scope of BHEL. Necessary guidance and procedures are in the scope of Supplier.
- 16.2 BHEL will provide only work cabin/ space within BHEL site office.

17. EXECUTION OF WORK

- 17.1 The work shall be executed in a workman like manner and to the entire satisfaction of BHEL Engineer and as per technical specification issued with tender. In case of conflict, the decision of BHEL Engineer shall be final & binding.
- 17.2 The work shall be executed to the complete satisfaction of BHEL Engineer and as per technical specification issued with tender. In case of conflict, the decision of BHEL Engineer shall be final & binding.
- 17.3 The work under the scope of this contract is deemed to be completed in all respects, only when all the works are carried out as per satisfaction of BHEL. The decision of BHEL on completion date shall be final and binding on the contractor.

- 17.4 In order to meet above schedule in general, and any other intermediate targets set, to meet customer/ project schedule requirements, bidder shall arrange & augment all necessary resources from time to time on the instructions of BHEL without any extra cost to BHEL.

18. CO-ORDINATION

- 18.1 Bidder to work in close coordination with Customer/ Customer Consultant/ BHEL Engineering Representative. The Customer/ Customer Consultant/ BHEL Representative is authorized to sign off and verify that supply has been performed in accordance with Customer/ Consultant/ BHEL design documents and drawings.
- 18.2 Bidder shall coordinate all Work with the BHEL's erection sub-contractor and Customer/ Customer Consultant/ BHEL Work Force to ensure maximum efficiency and safety.
- 18.3 Bidder shall perform all interrelated collateral and incidental Work required, but not specifically covered elsewhere to produce the desired intention of this Contract. The intended final result of this project is a sealed chimney liner in which neither flue gas nor moisture can escape in the chimney annulus space.
- 18.4 Bidder shall supply daily project monitoring, inspection reports, other project documentation.
- 18.5 Drawings and additional information pertinent to the work are in the scope of bidder.

19. PROGRESS REPORTING

- 19.1 Manufacturer/ authorized Supplier of OEM is required to draw mutually agreed monthly program in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.
- 19.2 The progress report shall indicate the progress achieved against planned, with reasons indicating delays, if any, and shall give the remedial actions which the Manufacturer/ authorised Supplier of OEM intends to take to make good the slippage or lost time, so that further works again proceed as per the original program and the slippages do not accumulate and effect the overall program.

20. DRAWING AND DOCUMENTS

- 20.1 The detailed drawings, specifications available with BHEL engineers will form part of this tender specification. These documents will be made available to the contractor during execution of work at site. The contractor will also ensure availability of all drawings/ documents at work place.

- 20.2 The data furnished in various annexures enclosed with this tender specification are only approximate and for guidance. However, the change in the design and in the quantity may occur as is usual in any such large scale of work.
- 20.3 Any error or ambiguity be discovered in the specification or information the supplier shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor.
- 20.4 Deviation from design dimensions should not exceed permissible limit. The supplier shall not correct or alter any dimension/ details, without specific approval of BHEL.

21. GUARANTEE PERIOD

Guarantee Period shall be 10 years' full replacement guarantee from successful trial operation of FGD. During the guarantee period if the lining system fails to protect the surface from deterioration, the contractor shall replace the partially affected portion or complete borosilicate glass block lining system and bear the complete cost of replacement including the cost of material supply, installation, etc. all complete, without any additional cost to BHEL.

22. SPECIAL ARRANGEMENTS FOR TACKLING PANDEMIC SITUATION

Contractor shall make arrangements for stay of workers within their premises as far as possible and/ or adjacent building and for implementation of STANDARD OPERATING PROTOCOL (SOP) as per government order. The transportation of workers to work place shall be arranged by the contractor in dedicated transport by ensuring social distance. Any person violating the pandemic measures published vide government order time to time will be liable to be proceeded for legal action as per the government order. Following shall be observed in work place:

- 22.1 All work places shall have adequate arrangements for temperature screening and provide sanitizers at convenient places.
- 22.2 Work places shall have a gap of one hour between shifts and will stagger the lunch breaks of staff, to ensure social distancing.
- 22.3 Use of AROGYA SETU will be encouraged for all employees both private and public.
- 22.4 Contractor shall sanitize their work place between shifts.
- 22.5 Large meetings to be prohibited. Spitting shall be strictly prohibited. Wearing of face cover is compulsory.
- 22.6 Government order (state/ center) being issued time to time for protective measures of pandemic shall be complied with strictly until government (state/ center) declares end of pandemic.

23. STANDARD OPERATING PROCEDURE FOR SOCIAL DISTANCING FOR WORKPLACE AND OFFICES

The following measures shall be implemented by contractor for their office and workplaces:

- 23.1 All areas in the work premises including the following shall be disinfected completely using user friendly disinfectant mediums:
- a. Entrance gate of work place, office, if any
 - b. Cafeteria and canteens, if any
 - c. Meeting room, conference halls/ open area available/ verandah/ entrance gate of site, bunkers, porta cabins, buildings, etc.
 - d. Equipments and lifts
 - e. Washroom, toilet, sink, water points, etc.
 - f. Wall/ all other surfaces
- 23.2 For workers coming from outside, special transportation facility shall be arranged without any dependency on the public transport system. These vehicles should be allowed to work only with 30-40% passenger capacity.
- 23.3 All vehicles and machinery entering the premise should be disinfected by spray mandatorily.
- 23.4 Mandatory thermal scanning of everyone entering and exiting the work place to be done.
- 23.5 Medical insurance for the workers to be made mandatory.
- 23.6 Provision for hand wash & sanitizer preferably with touch free mechanism shall be made at all entry and exit points and common areas. Sufficient quantities of all the items should be available.
- 23.7 Work places shall have a gap of one hour between shifts and will stagger the lunch breaks of staff, to ensure social distancing.
- 23.8 Large gatherings or meetings of 10 or more people to discouraged. Seating at least 6 feet away from others on job sites and in gatherings, meetings and training sessions.
- 23.9 Not more than 2/4 persons (depending on size) will be allowed to travel in lifts or hoists.
- 23.10 Use of staircase for climbing should be encourages.
- 23.11 There should be strict ban of gutka, tobacco, etc. and spitting should be strictly prohibited.
- 23.12 There should be total ban on non-essential visitors at sites.
- 23.13 Hospitals/ clinics in the nearby areas, which are authorized to treat pandemic patients, should be identified and list should be available at work place all the times.

24. LIST OF ANNEXURES:

1. BOQ cum Rate Schedule for the Scope of Work of "Design, Manufacturing and Supply of Borosilicate Glass Block Lining system, Expert Supervision for installation works of Borosilicate Glass Block Lining for 150 mtr height bi-flue chimney and Wet Stack Flow Model study as per Specification for 2x500 MW Tuticorin Thermal Power Plant at Tuticorin, Tamil Nadu".
2. Tentative Flue Gas Parameters

3. Technical Specification Part 1 - Section C - Specific Technical Requirements
4. Technical Specification Part 2 - Section D - General Technical Requirements
5. Technical Specification for Wet Stack Flow Model Study
6. Terms and Conditions for Deputation of Foreign Experts – NTPL Specification
7. Safety Clause - NTPL Specification

**2 X 500 MW NTPL TUTICORIN - BOROSILICATE LINING FOR ONE NO. 150 M HEIGHT ADDL. RCC CHIMNEY WITH BI-STEEL FLUE CHIMNEY
DESIGN AND SUPPLY OF BOROSILICATE GLASS BLOCK LINING SYSTEM, EXPERT SUPERVISION FOR INSTALLATION WORKS OF LINING WORKS IN CHIMNEY/ DUCT AND WET STACK
FLOW MODEL STUDY**

PRICE BID - BOQ CUM RATE SCHEDULE

S No.	Description	Unit	Total Quantity	Quoted Currency in INR /USD	CIF/ FOR Rate in Figures To be entered by the Bidder in INR/ USD	Total Amount
1	Design & supply of closed cell borosilicate glass block lining system, with minimum 51 mm thick borosilicate glass block, adhesive membrane having a minimum thickness of 3.2 mm and suitable primer, all conforming to physical and chemical properties mentioned in specification, testing, ten years full replacement guarantee, getting approval of design/drawings and installation procedure from BHEL/Customer etc. all complete as per specification, drawings and as directed by the Engineer-in-charge including cost of all the materials for the Borosilicate glass block lining system. Supply of mixing machines, special tools/ tackles and any other special T&P required for handling, storage, installation and test/ maintenance of borosilicate glass block lining system	SqM	6450			
2	Full-time onsite QA Supervision by borosilicate glass manufacturer through Experts with experience of atleast 5 years in technical support during surface preparation, application of primer, mixing of two components adhesives membrane by automated mixing machines, application of adhesive membrane & installation of borosilicate glass blocks, etc. all complete.	Man days	180			
3	Wet Stack Model Study - Conducting Condensate Collection Flow Model Study as per specification. The study shall comprise of the following as minimum: <ul style="list-style-type: none"> • Condensation calculations & design of condensate collection system • A scale physical flow model (minimum 1:12 scale) for liquid collector system (LCS) design. • A computational flow model for plume downwash analysis. • A physical or computational flow model for CEMS elevation flow performance. • Design of optimum choke geometry, if required. • Review & Approval of liquid collector system construction drawings. The scope of study shall be from mist eliminator outlet to top of the stack. Vendor shall ensure the completeness in all respects and for efficient & trouble free operation of chimney and liquid collection system for project. Vendor shall also include site inspection & supervision for 7 days to verify and evaluate LCS system performance prior to commissioning by the agency carrying out the study. The following codes and standard shall be followed for the conductance of this study: <ul style="list-style-type: none"> • Revised wet stack design guidelines, 2012 by EPRI • ACI 307 (American concrete institute code requirement for RC chimney) • EPRI report CS-2520 Entrainment in wet stack 1982 • EPRI report TR-109380 guidelines for fluid dynamic design of power plant ducts, 1998 • EPRI report GS-6984 FGD mist eliminator system design and specification guide • CICIND, ICAC, US EPA and other international and other latest codes and standards. 	Number	1			
	Total Amount in INR					

Tentative Flue Gas Parameters

S.No.	Project Name	No of Chimneys	Thickness in mm	Total Sq. M	Flue gas temperature at Stack inlet in Deg. C		Flue gas volume in m3/s		Clear Internal Flue Dia. in m	Steel flue ID in m
					Guarantee Point	Design Point	Guarantee Point	Design Point		
					1	NTPL Tuticorin FGD	1	51		
1.1	NTPL Tuticorin FGD			3,225.00	48.8	49.8	721.2244	766.3178	7.31 M	7.42 M
1.2	NTPL Tuticorin FGD			3,225.00	48.8	49.8	721.2244	766.3178	7.31 M	7.42 M



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**

SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-490-620-C002

VOLUME : IIB

SECTION : C

REV.NO. 00

SHEET

2X500 MW NTPL TUTICORIN CHIMNEY PACKAGE

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION-C SPECIFIC TECHNICAL REQUIREMENTS (RCC CHIMNEY)

**SPECIFICATION NO. PE-TS-490-620-C002
REV-00**



Bharat Heavy Electricals Limited

**Project Engineering Management
Power Sector, PPEI BUILDING, Plot No-25
SECTOR 16A, NOIDA-201301, UP**



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**

SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-490-620-C002

VOLUME : IIB

SECTION : C

REV.NO. 00

SHEET

PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**

SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-490-620-C002

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**SPECIFICATION FOR CIVIL, STRUCTURAL
AND ARCHITECTURAL WORKS**



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**

SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-490-620-C002

VOLUME : IIB

SECTION : C

REV.NO. 00

SHEET

SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS (RCC CHIMNEY)



**NLC TAMILNADU POWER LTD.
2 X 500 MW PROJECT
TUTICORIN, TAMIL NADU**

**TENDER SPECIFICATION
FOR
CHIMNEY**

VOLUME: II

TECHNICAL SPECIFICATION



**DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
BLOCK DG-4, SECTOR-II, SALT LAKE CITY
KOLKATA- 700 091, INDIA**

July, 2020

NLC TAMIL NADU POWER LTD.

2 x 500 MW PROJECT

TUTICORIN, TAMIL NADU.

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for Flue Gas Desulphurization Plant of 2X500 MW Coal based Thermal Power Plant located at Tuticorin, Tamil Nadu, India.

OVERALL CONTENTS

VOLUME – IA	:	Invitation for Bid
VOLUME – IB	:	Draft Contract
VOLUME II-A	:	Lead Specification including Project Management and Site Services
VOLUME II-B Sec I Part-A	:	General Technical Specification for Civil and Structural Works
VOLUME II-B Sec I Part-B	:	Civil Specification for Chimney structures
VOLUME II-B Sec I Part-C	:	Specific Design requirements of Civil
VOLUME II-B Sec II	:	Stack Elevator
VOLUME II-B Sec III	:	Electrical
VOLUME - III	:	Bid-Proposal Sheets [Technical Part]

**NLC TAMIL NADU POWER LTD.
2 X 500 MW PROJECT
TUTICORIN, TAMIL NADU**

OVERALL CONTENTS

VOLUME-I	:	General Conditions of Contract
VOLUME-II	:	Technical Specification
VOLUME-III	:	Bid Proposal Sheets [Technical Part]



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VOLUME-II TECHNICAL SPECIFICATION

VOLUMES DESCRIPTION

VOLUME II-A : Lead Specification

VOLUME II-B : Technical Specification For Chimney



CONTENTS

VOLUME: II-A

LEAD SPECIFICATION

SECTIONS

DESCRIPTION

SECTION-I	:	Lead Specification
SECTION-II	:	Project Management And Site Services
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VOLUME : II-B	TECHNICAL SPECIFICATION FOR CHIMNEY
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SECTION - I	TECHNICAL SPECIFICATIONS FOR CHIMNEY (CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS)
PART A	Common Part of Both Chimney Structure and Other than Chimney Structures
SUB SECTION-I	Geotechnical Investigation
SUB SECTION-II	Area Grading
SUB SECTION-III	Earthwork In Excavation And Backfilling
SUB SECTION-IV	Cement Concrete - Plain & Reinforced
SUB SECTION-V	Bored Cast-In-Situ Concrete Pile
SUB SECTION-VI	Fabrication Of Structural Steel Work
SUB SECTION-VII	Erection Of Structural Steel Work
SUB SECTION-VIII	Roads And Drainage
SUB SECTION-IX	Properties, Storage And Handling Of Common Building Materials
PART B	For Chimney Structures Only
SUB SECTION-I	General Specification And Design Criteria Of Chimney – Civil & Structural Works
SUB SECTION-II	Technical Specification For Construction Of Reinforced Concrete Chimney
PART C	Other than Chimney Structures
SUB SECTION-I	Specific Design Criteria - Civil
SUB SECTION-II	Specific Design Criteria - Structural
SUB SECTION-III	General Specification And Design Criteria For Architectural Works
SUB SECTION-IV	Masonry And Allied Works
SUB SECTION-V	Finish To Masonry And Concrete
SUB SECTION-VI	Metal Doors, Windows, Ventilators, Louvres, Curtain Wall, Structural Glazing, Etc.
SUB SECTION-VII	Anti-Termite Treatment



SUB SECTION-VIII	Rolling Steel Shutters, Grills And Collapsible Doors
SUB SECTION-IX	Glass And Glazing
SUB SECTION-X	Floor Finishes And Allied Works
SUB SECTION-XI	Painting, White Washing And Polishing Etc.
SUB SECTION-XII	Roof Water Proofing, Insulation And Allied Works
SUB SECTION-XIII	Water Supply
SUB SECTION-XIV	Drainage And Sanitation
SUB SECTION-XV	Fly Ash Blocks / Bricks

SECTION-II TECHNICAL SPECIFICATIONS FOR STACK ELEVATOR

SECTION-III TECHNICAL SPECIFICATIONS FOR CHIMNEY- ELECTRICAL WORKS

SUB SECTION-I	General Electrical Specification
SUB SECTION-II	A.C. Motors
SUB SECTION-III	Power Distribution Board
SUB SECTION-IV	Illumination
SUB SECTION-V	Cables
SUB SECTION-VI	Uninterruptible Power Supply (UPS)
SUB SECTION-VII	Grounding And Lightning Protection
SUB SECTION-VIII	Erection

ATTACHMENTS

DRAWINGS

- 18A09-DWG-C-0001 General Arrangement of 150 m high Bi-flue Chimney
- 18A09-CHM-DWG-E-0002 Single Line Diagram-Chimney Power Distribution Layout Chimney Arrangement





**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

DOMESTIC COMPETITIVE BIDDING

Tender No: COCONTS/ 0010 K/RT/NTPL/Addl. Chimney /2020, Dt. 01.07.2020.

Date & Time of Opening: 04.08.2020 at 15.00 Hrs. (IST)

TENDER SPECIFICATION

for

**Construction of One RCC Additional Chimney of 150 M height with
Borosilicate lined Bi-flue can arrangement for Flue Gas Desulphurization
Plant of 2X500 MW Coal based Thermal Power Plant located at Tuticorin,
Tamil Nadu, India.**

VOLUME – II A

LEAD SPECIFICATION INCLUDING PROJECT MANAGEMENT AND SITE SERVICES



Development Consultants Pvt. Ltd.

July 2020



VOLUME: IIA
LEAD SPECIFICATION
SECTION-I
CONTENT

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SECTION-I

LEAD SPECIFICATION

1.0.0 INTENT OF SPECIFICATION

1.1.0 GENERAL

This specification is intended to cover generally all the civil and structural work including all accessories, piling and foundation raft, painting etc. as necessary for the construction of a 150 M High twin flue (with borosilicate lining) RCC Chimney for discharging hot flue gas from the Boilers to the atmosphere. The specification also include all the electrical and mechanical items such as electrical power receiving, distribution, grounding, illumination, lightening protection, rack and pinion elevator and all other accessories needed to complete the chimney ready in all respects for its proper functioning.

The scope under this package will start from the terminal points of the flue ducts, covered under Other Package, terminating outside the windshield.

The scope of work under this specification has been delineated in details under clause No. 4.0.0.

1.2.0 CONTENT OF SPECIFICATION

The specification consists of Volumes-I, II, & III detailed index of which has been furnished in the respective volumes. This specification shall be read and construed in conjunction with the drawings and annexure to determine the scope of work and terminal points. Any variation arising during detailed engineering stage and erection & services will be taken into account by the Successful Bidder within his scope and time of completion.

The Bidder shall be responsible for providing all material, equipment and services specified or otherwise which are required to meet the intent and scope of this specification, ensuring high degree of reliability and ease of operation and maintenance. The civil construction, electrical & stack elevator shall conform to all aspects of high standards of engineering, design and workmanship and shall be capable of performing in continuous operation, in a manner acceptable to the Owner and shall also be in line with the current practice for reliable and efficient functioning.

1.3.0 INTERPRETATION

Owner shall interpret the meaning of the specification, drawings, requirement of materials of construction, construction methods, maintenance, etc., and shall have a right to reject or accept any work or material which in his assessment is not technically complete to meet





the requirements of this specification and/or applicable National and International standards mentioned, elsewhere in this specification.

Bidder is required to carefully examine and understand the specifications and seek clarifications, if required, to ensure that he has understood the specifications as intended by the Owner. In the absence of any specific clarifications sought by the bidder during bidding stage, the interpretation of Owner shall be final. The Bidder's offer should not carry any sections like clarifications, interpretations and/ or assumptions. All such points are required to be clarified during the bidding stage.

In the event of conflict between requirements of any two clauses of these specification/ documents or requirements of different codes/ standards, specified, the more stringent requirement as per the interpretation of the Owner shall apply and shall be binding to the Bidder.

In case all the above requirements are not complied with, the offer may be considered as incomplete and liable to be treated as non-responsive and rejected.

1.4.0 BRAND NAME

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood as establishing type, function and quality desired.

1.5.0 DISCREPANCY

In case there is any difference of content/ information between "Hard Copy" and "Soft Copy" of this specification document, the statement/ information as printed in hard copy shall prevail.

2.0.0 QUALIFICATION OF BIDDER

Bidder and his associates, sub-contractor(s) for sub-systems shall satisfy the Qualifying Requirements as detailed in "Volume - I: Conditions of Contract" for RCC Chimney Package.

Bidder shall furnish the details of their credentials as per instruction of General Conditions of Contract in Volume-I.

3.0.0 PROJECT SYNOPSIS AND GENERAL INFORMATION

3.1.0 PROJECT SYNOPSIS

NLC Tamil Nadu Power Limited (NTPL) is presently operating a thermal power plant having two units of 500 MW capacity each, in Tuticorin, Tamil Nadu.

The Bidder shall acquaint himself with the conditions prevailing at site by a





visit to the site, before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained/ collected by the Bidder.

3.2.0 APPROACH TO SITE

The site is accessed by National Highway No. 7A adjacent to plant. Due South connecting Madurai. The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km. Tuticorin sea port is located adjacent to the plant. Nearest airstrip is located at Pudukottai at a distance of 16.5 km. Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, 60 km away from the plant.

3.3.0 SALIENT METEOROLOGICAL DATA

For the purpose of equipment design, the following Meteorological data of site (as per IMD Tuticorin) shall be taken into consideration

- | | | |
|--------------------------------------|---|--|
| a) Ambient temperature | : | 36.5 °C maximum
20.8 °C minimum |
| b) Extreme Ambient temperature | : | 36.4 °C maximum (Annual)
24.1 °C minimum (Annual) |
| d) Relative humidity | : | |
| (i) Maximum | | 82% |
| (ii) Minimum | | 35% |
| (iii) Average | | 57 to 68% |
| e) Annual Rainfall | : | 437 mm |
| f) Wind load
(refer Vol-IIB also) | : | In accordance with IS-875, Part-3 |
| g) Seismic Zone
edition. | : | Zone II as per IS: 1893 latest |
| h) Altitude | : | 1.46 M above MSL |

4.00.00 SCOPE OF SUPPLY AND SERVICES

4.01.00 CIVIL WORKS

All Civil and Structural works for One (1) no. RCC Bi-flue Chimney 150 m high twin flue with borosilicate lining enclosed by RCC windshield to suit MOEF norms with Internal & External Platforms, ladders for access to roof top, Rack





& Pinion elevator etc. complete with all accessories and other associated system /subsystem consisting of, but not limited to, the followings:-

- All Civil and structural works for RCC Bi-flue Chimney 150M high with insulated / lined (borosilicate) steel flues enclosed by RCC Wind Shield to suit MOEF norms with Rack & Pinion Elevator.
- Other Auxiliaries, Internal Steel Platforms, External RCC Platforms, ladders, Rack & Pinion elevator etc.
- Structural steel staircase upto the top internal platform of the chimney
- Duct supporting arrangements as per functional requirements
- Electrical-cum-C&I building / Analyzer shelter to accommodate extractive type analyzer Panels, Data loggers / PC, DB and other necessary accessories. This will be a RCC framed-structured single-storey building (of adequate size to meet the electrical and C&I functional / layout requirements as mentioned elsewhere) with RCC roof. This building shall be provided to satisfy all functional and operational requirements of Electrical / C&I systems as specified elsewhere.
- Peripheral Roads / Paving (as required) along with Street Lighting.
- Service Drains as necessary.

The Reinforced Concrete Bi-flue Stack of 150M high shall comprise of two nos. lined (with Borosilicate) steel flues enclosed by a wind shield of reinforced concrete shell to suit MOEF norms with R&P Elevator.

The scope of this work shall consist of, but not limited to, the design and construction of reinforced concrete windshield, foundations with associated pipe work, Borosilicate lining, internal/external stairs, cage ladders, elevator, platforms, walkways as specified or required for operation and maintenance, access doors, galvanized MS handrails, steel fittings, fixtures, inserts including fabrication, galvanizing and erection of associated steel work and other chemicals on the completed structures etc. all complete as per functional requirements and as per directions of Owner.

For complete Civil-Structural scope and guidelines, Refer to Vol-II-B-Section-I-Part B; Subsection-I and II of this specification.

4.02.00 ELECTRICAL AND OTHER WORKS

Bidder shall refer Section-III of Vol. IIB for Electrical works.

4.03.00 MECHANICAL WORKS

Rack & Pinion type elevator inside of chimney shell.





4.04.00 OTHER REQUIREMENTS

Scope of work include obtaining necessary approvals, materials, execution as per Codes, specifications, best engineering practices and to the satisfaction of the Owner for all Civil/Structural, Mechanical and Electrical, C & I works.

Bidder shall visit and appraise himself fully with the existing site conditions including soil conditions, rainfall data and availability and transportation of all construction materials including backfill, granular materials, etc and other aspects for construction of the work covered under this package.

5.0.0 TERMINAL POINTS

- Terminal point of flue shall be One (1.0) m away from chimney shell at about 45 m height for both the units. The transition piece (rectangular duct to circular) shall be in bidder's scope. (The exact height shall be confirmed after getting FGD vendor's confirmation during detail engineering).
- Bidder shall refer Sub-section-I of Section-III (Vol. IIB) for Electrical terminal points.

6.0.0 EXCLUSIONS

- Forced ventilation system including the air inlet duct for the chimney.
- Rain water Harvesting is excluded from the scope of Bidder.

7.0.0 FACILITIES TO BE PROVIDED BY THE OWNER

7.1.0 LAND

Land, free of charge as available with the Owner for the construction of:

- Temporary Residential colony to be built by the Successful Bidder at his own expense for his workers near site with sanitary and drinking water facility.
- Site office, pre-assembly/storage yard to be constructed at Successful Bidder's own expense within the plant site.

7.2.0 CONSTRUCTION WATER & POWER

Construction water at one (1) point shall be made available free of cost and power supply at one (1) point at 11 KV AC \pm 10%, 3 Ph, 50 Hz. \pm 5% near the erection site shall be made available with meter; cost of





electricity will be charged at prevailing rate. Any other voltage, if required for any operation during construction, shall be arranged by the Successful Bidder from above source of Power supply. No separate drinking water supply shall be given.

8.0.0 DRGS / DOCUMENTS TO BE FURNISHED BY BIDDER ALONG WITH BID

All the sub-vendors should have the Qualifying Requirements as detailed in "Volume- I: Conditions of Contract" for Chimney Package.

- Write-up, description and illustrative drawings for the piling work to be carried out including name of sub vendor if any.
- Write-up, description and illustrative pamphlets of Aviation obstruction lighting system along with the control panel including name of supplier.
- Write-up, description and illustrative pamphlets of rack and pinion stack elevator including name of supplier.
- Write-up, description and illustrative pamphlets of insulation materials to be used including name of supplier
- Write-up, description and illustrative pamphlets of load bearing insulation and restraint blocks including name of supplier
- Write-up, description and illustrative pamphlets of expansion compensators including name of supplier
- Procedure of construction with a list of construction equipment proposed to be deployed.
- Write-up, description and illustrative pamphlets of elevator for slip/ jump/ climb form.
- Description and illustrative pamphlets of slip/jump/climb form shuttering system proposed to be deployed.
- Write-up, description and illustrative drawings for the Electrical erection work earthing work, lightening system etc. to be carried out including name of sub vendor if any.
- Write-up, description and illustrative drawings for the Electrical Main Panel, Emergency Panel and other Panel work to be carried out including name of sub vendor/ Manufacturer, if any.

9.0.0 DRGS/DOCUMENTS TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1.0 CIVIL WORKS

- Detail working drawings for construction, erection marking drawings





and sectional assembly drawings, detailed literature of materials of construction.

- Bar Bending Schedule of all concrete structures.
- Piling driving records and pile load test results.
- Fabrication drawings for all structural steelwork.
- Insert Details, Anchor bolt details
- Other drawings and data as necessary

Report of shop tests and test certificates of materials and performance test certificates.

- Manufacturing Quality Plans of all the systems & sub-systems.
- Field Quality Plans of all the systems & sub-systems.
- As-Built Drawings.

9.2.0 CHIMNEY ELEVATOR

- Technical Schedules.
- General arrangement, Layout drawing and section.
- Foundation plan, Loading & fixing details.
- Complete Electrical Control, Schematic wiring diagram.
- Write-up explaining the sequence of operation of control circuits/safety features.
- Reports on shop tests and test certificates.
- Bill of materials.
- Detailed erection and commissioning procedures.
- Test procedures.
- Routine test, type test, Acceptance test certificates.
- Manufacturing Quality Plan.
- Painting and Surface preparation procedure.
- Field Quality Plan.





- Operation and Maintenance Manual.
- As-Built drawings.

9.3.0 ELECTRICAL WORKS

Bidder shall refer Sub-section –I of Section-III (Vol. IIB) for “list of drawings” to be submitted.

10.0.0 LAYOUT

The Successful Bidder shall carryout the setting out of piles, foundation and structures and provides levels, with reference to general existing grid and Bench Mark. If the Successful Bidder uses the grid, benchmarks and reference pillars made by other package contractors, he shall co-ordinate with the contractors and shall satisfy himself of the accuracy of the reference marks. If he is required to set out the foundation afresh, he shall do so independently with reference to the one existing grid and benchmark, which has been followed by other agencies at the instruction of the Engineer. In case any discrepancy is found, it should be immediately brought to the notice of the Engineer for any rectification/modification necessary. No complaint will be entertained at a later stage. The Successful Bidder shall accurately set out the positions for holding down bolts and inserts as applicable.

If required, in the option of the Engineer, the bidder shall construct pillars for grid, references and benchmarks and maintain them till completion of the construction. He shall also help the Engineer with instruments, materials and labours for checking the detailed layout and levels. The Successful Bidder shall be solely responsible for the correctness of the layout and levels. The Bidder shall take into account the cost of these while quoting rates.

11.0.0 WORKMANSHIP

The Successful Bidder shall execute the work with such material and labour so that best standard of workmanship at all stages of construction is achieved, as aimed under this specification. The Successful Bidder shall engage skilled labour for all work except for those, which normally do not require skilled labour.

If the bye-laws of the local Government, Municipal or other authorities require the employment of licensed or registered workmen for various trades, the Successful Bidder shall arrange to have the work done by such registered or licensed personnel. In case of manufactured items being used in the work, the Successful Bidder shall arrange to have at site, at his own cost, the services of the supervisors of respective manufacturers to ensure that the work is done in accordance with the specification and requirement.





12.0.0 TEMPORARY WORK

All scaffolding, staging, bracing and other necessary temporary work required for proper execution of the job shall be provided by the Successful Bidder at his own cost and rate shall be inclusive of providing of all materials, labour and supervision. The layout and details of such temporary work shall have prior approval of the Engineer; but the Successful Bidder shall be responsible for proper strength and safety of the same.

All temporary work shall be so constructed as not to interfere with any permanent work or with the work of other agencies. If it is necessary to remove any of the temporary work at any time to facilitate execution of the work or work of other agencies, such removal and re-erection if required, shall be carried out by the Successful Bidder, at the discretion of the Engineer without any delay and any extra cost on this account shall be borne by the Successful Bidder.

13.0.0 SEQUENCE OF WORK AND PROGRESS REPORT

The sequence in which the work is to be carried out shall be as approved by the Engineer in accordance with the Construction Method accepted by the Engineer and to be followed by the Successful Bidder. A programme of work is to be submitted for the Engineer's review and approval and this has to be periodically updated and modified as per actual progress to enable timely completion. The Successful Bidder shall regularly submit to the Engineer progress reports for periods of working as specified by the Engineer showing upto date progress on all-important items of work.

14.0.0 TIME OF COMPLETION

All works within the scope of this tender shall have to be completed within a period of **twenty-one (21) months** from the date of issue of work order. The construction at site must commence within two (2) weeks from the said date.





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

VOLUME: IIA

SECTION-II

PROJECT MANAGEMENT AND SITE SERVICES



Development Consultants Pvt. Ltd.

**Vol. II-A/Section-II
Project Management & Site Services**



**Tender Specification
for
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**NLC Tamil Nadu Power Ltd.
2x500 MW Project
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VOLUME: IIA

SECTION-II

PROJECT MANAGEMENT AND SITE SERVICES

1.0.0 PROJECT MANAGEMENT SERVICES

1.1.0 RESPONSIBILITY

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this Contract. Responsibilities of this project Management team shall cover the areas listed below:

- a) Planning and Monitoring
- b) Engineering Management
- c) Contracts Management
- d) Quality Assurance, Inspection & Expediting
- e) Construction Management
- f) Spares Management
- g) Commissioning Management

Detailed responsibilities in the above areas are discussed below:

1.2.0 ORGANISATION

1.2.1 Headquarters

The headquarters of the project management team shall be headed by a senior level executive designated as the Project Manager, who shall be responsible to Owner for the execution of the project.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.1.0, who, in turn, will report to the Project Manager for all matters relative to this contract.

1.2.2 Central Co-ordination Cell

The central coordination cell shall preferably be based in Tuticorin and shall have sufficient technical personnel to coordinate technical matters and to quickly





resolve day to day queries or references made by the Owner and his Consultants without having the need to refer to his headquarters each time.

1.2.3 Site Organisation

The site should have a competent construction manager for all site operations with sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.2.4 Organisation Chart

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.1.0 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation. Organisation chart shall be furnished as per the form duly filled as mentioned in GCC.

1.3.0 Implementation schedule

The schedule for the completion of the new 150 m high Twin Flue RCC Chimney for their existing 2 x 500 MW Power plant of NLC Tamil Nadu Power Ltd. Would be as follows :

Sl. No.	Item of Work	Period in Months from Zero date (Taken from the date of issue of Letter of Award)
	a. Test Piles & Load test	2
	b. Piling	5
	c. Pile Cap	7
	d. Shell Construction	14
	e. Platforms, Flue Erection & Insulation	18
	f. Elevator Erection, Aviation Lighting & Commissioning	21

To achieve these overall targets, the Contractor shall furnish to the Owner, various schedules as defined below:

1.3.1 Engineering Schedules

These schedules shall cover various submissions indicating different engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every sub-systems/ items of work covered in the scope of this specification.





1.3.2 Manufacturing Schedule

The Contractor shall submit to the Engineer his manufacturing and delivery schedules for the equipment within thirty (30) days from the date of issue of the Letter of Award (LOA). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.

1.3.3 Construction & Erection Schedules

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering construction and erection sequence, testing and commissioning activities. These schedules may be based on the recommended construction and erection procedures and will be subject to discussions/ agreements with the Owner subsequent to the award of contract.

1.3.4 The successful Bidder shall have to provide all the above schedules (i.e. 1.3.1, 1. 3.2 & 1.3.3) in a tabular form in addition to that in the form of network and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.3.5 The Contractor shall provide the Owner the original floppy/disc/software for all such schedules along with requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software.

1.4.0 DETAILED RESPONSIBILITIES

1.4.1 Planning & Monitoring

a) Planning

The Bidder shall prepare a Master Network Schedule in the form of PERT network consisting a more detailed break-up of activities.

The network shall be prepared on a Work Breakdown Structure for the work package which sub-divides the work into a set of specific systems/ sub-systems. The master network will identify milestones of key events for





each system in the areas of procurement, testing, construction, fabrication, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Successful Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and construction activities. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.

b) Monitoring & Progress Reporting

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

- i) Report on key milestones including gap analysis and remedial measures.
- ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) Detailed status of engineering submissions, quality plan submissions and approval, procurement, manufacture and despatch.

The monthly report generated from the site office should necessarily include:

- i) Report on key milestones. including gap analysis and remedial measures.
- ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) This report would also cover the areas pertaining to the receipt of the construction materials, equipment, transport, receipt at site, erection and commissioning.



- vi) This report would also cover the areas pertaining to the construction activities at site and progress achieved, cumulative and during the reporting period.

In addition to the above, as the Contract execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of E-Mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.4.2 Quality Assurance, Inspection and Expediting

The Contractor shall obtain approval of the list of sub-vendors from whom the equipment/materials are expected to be procured and the quality assurance plans thereof for the manufacture which shall need approval by the QA group of Owner before the manufacture is commenced. The prospective list of suppliers may be submitted along with the bid for approval by the Owner at the time of award of contract. On the approved quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.4.1 above. Despatch of fabricated materials, equipment & materials shall be sequential matching erection activities as well as schedule.

1.4.3 Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award the Contract, the Contractor shall submit a programme of construction/ erection/ commissioning, either in continuation with the fabrication, manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be required by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring.

The L-3 programme would be jointly finalised by the site-in-charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.





1.5.0 PROJECT PROGRESS REVIEW MEETINGS

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution in respect of this new Chimney package for existing 2 x 500 MW thermal Power plant of NLC Tamil Nadu Power Ltd. will be held at least once in one (1) month at site or in the country of the Contractor depending on the circumstances and mutual agreement. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings at site between the Contractor and the Owner will be decided upon as part of erection coordination procedure.

1.6.0 OWNER'S CONSULTANT

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.1.0 above. The details of interaction and procedures for coordination between Owner/Owner's Consultant and Contractor/Contractor's project management team shall be finalised during contract negotiations.

2.0.0 SITE SERVICES

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

- 2.1.0 Arranging procurement of construction material, dispatch from the fabrication yard.
- 2.1.1 Deployment of all skilled and unskilled manpower required for construction, fabrication, erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.
- 2.1.2 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.
- 2.1.3 Supply of all consumables, e.g. welding electrodes, cleaning agents, diesel oil, lubricant, chemicals etc. as well as materials required for temporary





supports, scaffolding etc. as necessary for such erection work except those listed under exclusion elsewhere in this specification.

- 2.1.4 Construction of all civil/structural/architectural works, including construction of foundation as required, grouting, and all other incidental civil activities as detailed elsewhere.
- 2.1.5 All structural steel fabrication and erection work as detailed elsewhere in the specification.
- 2.1.6 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.
- 2.1.7 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Factory Inspector, Electrical Inspector etc. for respective portions of work under the jurisdiction of such statutes or laws.
- 2.1.8 The Contractor shall provide 'Industrial Relations' unit and 'Medical' unit to take care of his erection staff and the Owner shall have no obligation in this regard.

2.2.0 SITE ORGANISATION

The Contractor shall maintain, a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.





The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

2.3.0 GENERAL GUIDELINES FOR FIELD ACTIVITIES

2.3.1 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

2.3.2 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication.

2.3.3 The Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.

2.3.4 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

2.3.5 The Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

2.3.6 The works under execution shall be open to inspection & supervision by the Owner's engineer at all times. The Contractor shall give reasonable notice to





the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.

- 2.3.7 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.
- 2.3.8 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.
- 2.3.9 All the works such as cleaning, checking, levelling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipment for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.
- 2.3.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Engineer.
- 2.3.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Engineer, will have to be done by the Contractor without any cost implication to the owner.
- 2.3.12 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Engineer, with all the necessary tools & tackles, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.
- 2.3.13 Additional platforms for approaching different levels as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.



2.3.14 It shall be the responsibility of the Contractor to provide ladders for initial works till such time stairways are completed. For this, the ladder should not be welded and should be prefabricated clamping type. No temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.

2.3.15 Structural materials required for the supporting/operating platforms required at various levels will be arranged by the Contractor.

2.4.0 SAFETY

2.4.1 The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.

2.4.2 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.

2.4.3 Storage of petroleum products for construction work shall be as per rules and regulation laid down in Petroleum Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from statutory authorities shall be the responsibility of the Contractor.

2.4.4 The Contractor shall be responsible for safe storage of his and his sub-contractors radioactive sources if any.

2.4.5 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.

2.4.6 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, and fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.



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- 2.4.7 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.
- 2.4.8 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.
- 2.4.9 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.
- 2.4.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.
- 2.4.11 All safety precautions shall be taken for welding and cutting operations as per IS-818.
- 2.4.12 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.





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SECTION - III
ENGINEERING SERVICES**



Development Consultants Pvt. Ltd.

**Vol. II-A/Section-III
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VOLUME : II-A

SECTION-III

ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Successful Bidder shall be responsible for proper Owner's Engineering and co-ordination of activities during various phases of execution of the contract. The Successful Bidder shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Owner's Engineer or the Review Consultant shall interact on matters related to Owner's Engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Successful Bidder and shall be responsible for all Owner's Engineering co-ordination. The Owner /Consultant /Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Successful Bidder or on matters involving the Successful Bidder, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the Successful Bidders. However such interaction will not, under any circumstance, dilute the responsibility of the Successful Bidder to provide a fully Owner's Engineered and coordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of Owner's Engineering information will be mutually agreed and finalized between the Owner and the Successful Bidder.

2.00.00 DESIGN COORDINATION MEETING

The Successful Bidder and his sub-vendors will be called upon to attend design co-ordination meetings with the Owner's Engineer, other Successful Bidders and the Consultants of the Owner during the period of execution of contract. The Successful Bidder including his sub-vendors shall attend such meetings at their own cost at Owner's office in Tuticorin or Consultant's office in Kolkata/ or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.00.00 CO-OPERATION WITH OTHER BIDDERS AND CONSULTING OWNER'S ENGINEERS

The Successful Bidder shall agree to cooperate with the Owner's other Bidders and Consulting Owner's Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Owner's Engineer shall be provided with copies of all correspondences





addressed by the Successful Bidder to other Sub- Vendors and Consulting Owner's Engineers in respect of such exchange of technical information.

4.00.00 GUIDELINES FOR OWNER'S ENGINEERING SERVICES

- 4.01.00 Prior to commencement of the Owner's Engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed Owner's Engineering work.
- 4.02.00 Owner's Engineering work shall be performed on modern and proven concepts and internationally accepted good Owner's Engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the Owner's Engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Successful Bidder.
- 4.03.00 At any stage during the performance of assignment, the Successful Bidder may be required to make certain changes/modification/improvements in design/drawing/other documents, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the Chimney package and its systems/sub-systems/components in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution/operation of similar units. Such changes/ modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and Scope of the Successful Bidder.
- 4.04.00 During the course of review of detailed Owner's Engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.
- 4.05.00 During the course of review of detailed Owner's Engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants Owner's Engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.
- 4.06.00 It is not the intent to give details of every single task covered in the total Owner's Engineering work to be carried out by Successful Bidder, however, all Owner's Engineering work required for the satisfactory completion of the Chimney Package as specified shall be carried out by the Successful Bidder. Broadly, the following are the minimum requirements in respect of scope of major items of work:
- 4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned drawings (Chimney GA- detailed



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plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities.

Drawings and Schedules prepared by the Successful Bidder from time to time, as detailed designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.

- 4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-Vendors.
- 4.06.03 Review of sub-Vendor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.
- 4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments, etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.
- 4.06.05 Not used.
- 4.06.06 Preparation of consolidated schedules and bills of materials, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the Chimney package including dampers, ducting etc.
- 4.06.07 Not used.
- 4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.
- 4.06.09 Certification and submission of final as-built drawings for all areas.
- 4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.
- 4.06.11 All erection and assembly drawings which may be required at site.





5.00.00 **INSTRUCTION MANUALS**

5.01.00 The Bidder shall provide all necessary instruction manuals for the Owner's review, comment, and final acceptance as required in the contract. The instruction manual shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

5.02.00 **Erection Manuals**

5.02.01 The erection manuals shall be submitted at least three (3) months prior to commencement of erection activities of particular equipment/system. The manuals shall contain the following as a minimum:

- a) Erection strategy.
- b) Sequence of erection.
- c) List of tools, tackles, heavy equipments like cranes, dozers etc required for erection.
- d) Bill of Materials.
- e) Safety precautions to be followed during erection.
- f) Erection instructions.
- g) Critical checks and permissible deviation/tolerances.
- h) Check-list for pre-commissioning activities
- i) Check-list for commissioning of the system.
- j) Procedure for initial checking, testing and acceptance norms.

5.03.00 **Operation & Maintenance Manuals**

5.03.01 The operating and maintenance instructions together with drawings of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble, and adjust all parts of the equipment. They shall outline a step-by-step procedure for all operations likely to be carried out for Chimney package. Each manual shall include a complete set of drawings together with performance/ rating curves of the equipment and test certificates wherever applicable.

5.03.02 If after commissioning and initial operation of the Chimney, the manuals require any modification/ additions in the view of the Owner or Bidder, the same shall be incorporated and the updated final manuals shall be submitted to the





Owner.

5.03.03 The manuals shall include the following:

- a) List of spare parts along with their drawing and catalogue and Pro-forma for ordering spares.
- b) Location and identification guide for bearings of various equipments and lubrication schedule including charts showing lubrication checking, testing and replacement procedure.
- c) Wherever applicable, fault location charts shall be included to facilitate fault detection.
- d) Detailed specification for all consumables (including lubricating oils, greases, chemicals etc.) required for each equipment.

6.00.00 PLANT HANDBOOK FOR CHIMNEY PACKAGE

The Bidder shall provide the plant handbook for Chimney Package to the Owner as per provision of the contract.

The Plant Handbook shall contain the following as a minimum:

- a. Design and performance data
- b. Single line diagrams
- c. Sequence & Protection interlock schemes
- d. Alarm and trip values
- e. Performance curves
- f. General layout plan and layout of buildings
- g. Important Do's and Don'ts.

7.00.00 TENDER STAGE DOCUMENT SUBMISSION

7.01.00 The Bidder shall submit along with his bid all documents/drawings as specified in specification and respective sections of the Technical Specifications in Vol-II and Vol-III. The documents shall include but not be limited to the following:

- a) All Bid proposal sheets duly filled up.
- b) Detailed experience list and financial resources of the Prime Bidder his collaborators/associates in this bid as well as the sub-vendors proposed.





- c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.
- d) List of terminal points of the package offered together with quality and quantity of various input (i.e. steam, water, air, electricity etc.) as required from the Owner at such interfaces.
- e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.
- f) High level project schedule network indicating target dates for intermediate milestones and final commissioning of Chimney Package; This network shall be supplemented by a detailed write-up on proposed sequence and method of execution for project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.
- g) Sub-vendor List for the Equipment, as mentioned in Annexure-1, for approval by Owner/Consultant.

8.00.00 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

8.01.00 Owner's Engineering schedule shall be submitted by the Bidder as indicated in the specification. Owner's Engineering schedule shall be developed in format as desired by the Owner/consultant.

The documents shall be divided into two categories: a) for approval and b) for information/further Owner's Engineering and co-ordination by the Consultant.

In preparing this schedule, the Bidder shall allow one (1) week from date of receipt for review and comments by the Consultant for each submission of a document.

This document submission schedule shall require acceptance by the Owner/Consultant.

Bidder shall also develop and submit a Master drawing list to the Owner/consultant.

8.02.00 All contract documents shall be marked with the name of the Owner, the Project, the specification title and number and the unit designation.

All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

8.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or





revised as required and submitted as certified contract document for approval/information of the Owner/Consultant.

8.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant:

- b) Design basis documents / memoranda / calculations.
- c) Equipment data sheets and general arrangement drawings.
- d) Materials of construction.
- e) General Arrangement and Layout drawings.
- f) Typical control schemes, circuit diagrams, drive/ feeder-wise control scheme showing all external interfaces.
- g) Control System Configuration
- h) Shop Inspection and Testing Procedures, Test Set-up & Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.
- i) Performance Test Procedures, Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.
- j) Schedules covering equipment delivery schedules, erection, testing and commissioning schedules at L1 and L2 levels.

8.05.00 Unless specified otherwise, the following categories of documents / drawings would be treated for information/further Owner's Engineering by the Owner/Consultant. The Bidder shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/ Consultant.

- a) Equipment foundation drawings.
- b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
- c) Predicted performance curves of equipment.
- d) Various bills of quantity, schedules etc.
- e) Piping/flue fabrication drawings etc.
- f) Panel wiring diagrams.
- g) Instruction/Operation manuals.
- h) Service manuals and trouble shooting guide for C & I system including



field instruments.

- i) Operation logic diagrams.
- j) Cable schedule and interconnection chart.

In essence, the Bidder is solely responsible for corrections and adequacy of design & Owner's Engineering for documents under this category.

8.06.00 Upon review, the Consultant shall put his remarks and one of the following action stamps on the drawing / document:

- 1) Approved.
- 2) Approved as noted, resubmission required.
- 3) Commented, resubmission required.
- 4) For information/reference only.

For action stamps in category (2) & (3), documents must be resubmitted for review by the Owner/Consultant.

Except for action stamp under category (3), the Bidder can proceed with manufacturing and other sequential activities for those areas of a drawing/document. .

The Consultant may accord approval in category (2) or (3) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Bidder shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds.

The Bidder's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Consultant.

8.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

8.08.00 For review by the Consultant, the Bidder shall furnish three (3) prints of each drawing (only for first submission). There upon all transaction of drawings including reviewed comments and stamping shall be done in soft. All transaction of drawings shall be accompanied by a reference letter mentioning the date, revision no. and document status. Only on receiving the Approval Stamping, bidder shall distribute 6 sets of drawings (2 at NTPL corporate office and 4 sets at NTPL site office). The Bidder shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

8.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the more stringent stipulations shall prevail.





ANNEXURE-1 FINALIZATION OF SUB VENDORS

General

- a. The successful Bidder is responsible for performance/guarantee of the complete package including bought out items and out sourced processes. The Bidder will supply the equipment/component/system from the Purchaser/Consultant approved sub vendors only.
- b. The Bidder has to necessarily indicate in their bid, their proposed sub vendors for the items listed below. Sufficient number of sub vendors may be proposed to meet their need.
- c. The proposed list of sub vendors furnished by the Bidder will be reviewed during Techno Commercial/Pre-award discussions by Purchaser/Consultant and the sub vendors will be categorized as below.
 - i. **Category – I: Sub vendors accepted.** The acceptance will be based on past experience of Purchaser/Consultant.
 - ii. **Category – II: Sub vendors enlisted for future acceptance.** Such acceptance will be based on the various details regarding capacity, capability, experience etc of the sub-vendor proposed by the successful Bidder. It is the responsibility of the successful Bidder to get the details of the sub vendors under category II, compiled and submitted to Purchaser/consultant for scrutiny and acceptance. The acceptance criteria are mentioned below. However, Purchaser reserves the right to accept or reject any of the proposed vendors based on information available with them.
- d. The consolidated list of sub vendors under category I and category II will be made available to all the qualified Bidders before price cover opening.
- e. Purchaser may consider the Bidder's proposal for inclusion of new sub vendors, if any during post award stage for approval, based on merits, in the overall interest of the Package, after establishing that the sub vendors proposed meet the acceptance criteria specified. However, price advantage if any, arising out of inclusion of new sub vendors will be passed on to the Purchaser.
- f. Subsequent to approval of main sub vendor for main system after verifying the acceptance criteria, the main sub vendor will be allowed to choose his sub vendors for the sub system provided they meet the technical stipulation as per the contract requirements.
- g. For all other components/equipments/systems which are not figuring in the following list or in the additional list furnished by the Bidder in their bid, Bidder's standard practice of selection of vendors may be carried out.
- h. The items listed are not exhaustive. Hence if considered necessary the Bidder can include additional items and indicate their proposed sub vendors for those items also.



Acceptance Criteria for Sub Vendors:

**i) For all Mechanical, Electrical, Control and Instrumentation
(Except for items mentioned under ii and iii below)**

For Class I Items:

Bidder to furnish documentary evidence to show that similar or higher capacity component/equipment / system has been supplied by the vendor or their associate/collaborator and the same has been operating satisfactorily for two years. The documentary evidence will be in the form of Performance certificates furnished by the end user.

For Class II Items:

Bidder to furnish documentary evidence to show that similar or higher capacity component/equipment / system has been supplied by the vendor. The documentary evidence will be in the form of Material Receipt Certificate or Site Inspection Report, etc from the end user for having received the material by the end user.

The component/equipment / system covered under Class I and Class II are furnished below for Mechanical, Electrical, Control and Instrumentation.

ii) C & I items –Nil

iii) For all civil items

- (a) It should conform to relevant Indian/international Standards.
- (b) It should be of reputed makes supplied to similar construction / infrastructure projects.
- (c) The Bidder should furnish documentary evidence to prove (a) and (b) above

iv) For Cement:

- (a) It should conform to relevant Indian /International Standards.
- (b) It should be of reputed makes supplied to similar construction/infrastructure projects.
- (c) For Cement, minimum quantity of supply shall be 2500 MT for single project. The Supply Order and documentary evidence in the form of material receipt certificate or site inspection report from the end user for having received the material by the end user, shall be produced as documentary evidence.
- (d) The Bidder should furnish documentary evidence to prove (a), (b) and (c) above.



v) For reinforcement steel:

- (a) The quality shall conform to Indian Standard/International Standards.
- (b) The Firm should have been in the market for a minimum period of 3 years as on the original date of Tender opening and should have supplied & used the reinforced steel in any industrial project.
- (c) For reinforcement steel- minimum quantity of supply & used shall be 1000MT for a single project. The Supply Order and documentary evidence in the form of material receipt certificate or site inspection report from the end user for having received the material by the end user shall be produced as documentary evidence.
- (d) The Bidder should furnish documentary evidence to prove (a) (b) and (c) above

vi) For Structural steel (for use in civil & structural buildings only):

- (a) The quality shall conform to relevant Indian Standard/International standards.
- (b) The firm should have been in the market for a minimum period of 3 years as on the original date of tender opening and should have supplied & used the structural steel in any industrial project.
- (c) For Structural steel- minimum quantity of supply & used shall be 1000 MT for a single project. The Supply Order and documentary evidence in the form of material receipt certificate or site inspection report from the end user for having received the material by the end user shall be produced as documentary evidence.
- (d) The Bidder should furnish documentary evidence to prove (a), (b) and (c) above.

vii) For supply of Borosilicate Glass Blocks with primer and adhesive (Termed as Borosilicate block lining system) - (For use in the application inside the steel flue can)

- (a) The Firm should be a manufacturer of Borosilicate Lining System or authorised supplier of the manufacturer (OEM) and should have supplied, erected/ supervised erection of Borosilicate Block Chimney Lining system for at least one (1) number of RCC chimney of minimum 150 Meters height with steel flue can in a power plant.
- (b) The above Borosilicate block Chimney Lining system should have



completed satisfactory operation for a period of not less than one (1) year as on the original scheduled date of Tender opening.

- (c) The Bidder should furnish documentary evidence to prove (a) & (b) above by furnishing the following documents:
- i. Bidder shall furnish the PO copy / supporting documents of at least one (1) executed Contract as mentioned in 'a' above.
 - ii. Corresponding certificate from owner for successful operation of 'borosilicate Glass block lining system' as mentioned in 'b' above indicating date of commissioning.

NOTE:

During the application of the Borosilicate Lining system, the sub vendor who is supplying the Borosilicate Lining system shall also supply sufficient number of skilled supervisors to assist the Application of the Borosilicate Lining system by the successful bidder. A separate QA plan towards this shall be furnished before starting of the works by the sub vendor for the approval of the owner.

ACCEPTANCE CRITERIA FOR SUB CONTRACTORS

i) For Mechanical and Electrical works:

Contractor to furnish documentary evidence to prove that similar mechanical / electrical erection and installation work had been carried out by the Sub contractor.

ii) For Civil & Structural works:

All Civil and Structural works related to Chimney, shall be carried out by the successful bidder as per QR requirements by which the successful bidder got qualified.

iii) Agency for conducting the Wet stack flow model Study:

A. The sub-contractor should have carried out one (1) No. wet stack flow model study along with design of the condensate collection system for the wet stack installed after wet limestone based FGD absorber in a coal/lignite fired power plant, which is in successful operation for a period of at least one (1) year as on the original scheduled date of Tender opening.

The bidder shall furnish the following supporting documents for approval of Wet stack flow model study agency:

- a. Bidder shall furnish the PO copy/ study reports of at least one



executed contract as mentioned in 'A' above.

- b. Owner performance feedback certificates for executed wet stack flow model study for the reference project as in (A), which has been successfully in use for at least one year as on the original scheduled date of Tender opening indicating the project name, date of issue of certificate and name/ designation of the certificate issuer.

However the final approval of the sub contractor for conducting the wet stack flow model study lies with the NLC / NTPL. The successful bidder shall place the order on this firm only after getting the consent / approval from NLC / NTPL to hire the services of the wet stack flow model study agency.

LIST OF EQUIPMENTS – Mechanical

- i) **Class I items: Items for which Performance certificates shall be furnished for approval of Category II sub vendors during detail engineering**

(a) Technological Items

Sl.No	Item Description	Sub Vendors
1.	Flue COR-TEN B	
2.	Flue Top 10m SS316 or BS 1449	
3.	Stack Elevator	

(b) Air Conditioning & Ventilation System

Sl. No	Item Description	Sub Vendors
1.	Air Conditioning System	
2.	Ventilation System	

- ii) **Class II items: The documentary evidence for approval of Category II sub vendors shall be in the form of Material Receipt Certificate or Site Inspection Report, etc from the end user for having received the material by the end user.**

(a) Technological Items

Sl. No	Item Description	Sub Vendors
1.	Welding electrodes	



LIST OF EQUIPMENTS –Electrical

Class I items:

Sl. No	Item Description	Sub Vendors
1.	Auxiliary Relays	
2.	Electro Mechanical Relays	
3.	L.T. Motors (AC & DC)	
4.	Lighting Transformer	
5.	LT Control Cables	
6.	LT Power Cables(XLPE)	
7.	LT Trailing Cables	
8.	Numerical protection Relays	
9.	MLDB/PDB/ACD/WDB/ELDB / DCDB / LCP / LPBS / DCLDB	
10.	UPS	

Class II items:

Sl. No	Item Description	Sub Vendors
1.	AC/DC Control Contactors	
2.	AC/DC Power Contactors	
3.	Cable Glands	
4.	Cable Lugs	
5.	Cable Termination & Jointing Kits	
6.	Cable Trays	
7.	Control Transformers	
8.	Current Measuring Modules	
9.	Energy Meters/Multi Function Meters	
10.	High Mast	
11.	LED Lighting	
12.	Lighting Fixtures (Flame Proof)	
13.	Lighting Fixtures (General)	
14.	MCCB/MPCB/MCB	
15.	Meters (Analog/Digital)	
16.	Street Light Poles	
17.	Transducer	

LIST OF EQUIPMENTS – CONTROL & INSTRUMENTATION

Class – I items: Nil

Class II items: Nil

LIST OF EQUIPMENTS – Civil & Structural Supply Portion

a. Building Materials





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Sl. No	Item Description	Sub Vendors
1.	Steel doors, windows and ventilators / Pressed door, including accessories	
2.	Aluminium doors, windows, partitions and grill	
3.	FRP Doors including all accessories	
4.	Water proofing compounds	
5.	Interior Emulsion paint	
6.	Synthetic paint	
7.	Painting over steel work	
8.	Metallic Floor Hardener	
9.	Non-skid fully vitrified tiles	
10.	Water proof cement paints and exterior emulsion paints	
11.	Borosilicate blocks, adhesive and Primer	

b. Sanitary and Water Supply Work

Sl. No	Item Description	Sub Vendors
1.	W.C. Pan Wash Basin, Urinals Sink Low down flushing Cistern & EWC	
2.	Colour/White Glazed Tiles, Heavy Duty Ceramic tiles and Vitrified Tiles.	
3.	HDPE Water tank	
4.	DI Pipes	

c. RCC Items

Sl. No	Item Description	Sub Vendors
1.	Cement	
2.	Reinforcement Steel	

d. Structural Steel

Sl. No	Item Description	Sub Vendors
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**Tender Specification
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Sl. No	Item Description	Sub Vendors
1.	Structural Steel	

Category – I: Sub vendors accepted. Bidder will select the vendors of Category I without any approval of Purchaser/Consultant (Only for Civil Items)





**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

DOMESTIC COMPETITIVE BIDDING

Tender No: COCONTS/ 0010 K/RT/NTPL/Addl. Chimney /2020, Dt. 01.07.2020.

Date & Time of Opening: 04.08.2020 at 15.00 Hrs. (IST)

TENDER SPECIFICATION

for

**Construction of One RCC Additional Chimney of 150 M height with
Borosilicate lined Bi-flue can arrangement for Flue Gas Desulphurization
Plant of 2X500 MW Coal based Thermal Power Plant located at Tuticorin,
Tamil Nadu, India.**

VOLUME – II B SEC - I

PART - A: GENERAL TECHNICAL SPECIFICATION FOR CIVIL AND STRUCTURAL WORKS

PART - B: CIVIL SPECIFICATION FOR CHIMNEY STRUCTURES

PART - C: SPECIFIC DESIGN REQUIREMENTS OF CIVIL



Development Consultants Pvt. Ltd.

July 2020



Tender Specification
for
Chimney

NLC TamilNadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: A

SUB SECTION: I

**GUIDELINE
FOR
GEOTECHNICAL INVESTIGATION**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part A; Sub Section: I
Geotechnical Investigation



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**VOLUME: II-B
SECTION: I**

PART: A

SUB SECTION: I

**GUIDELINE
FOR
GEOTECHNICAL INVESTIGATION**

1.00.00 SCOPE

This specification covers the complete soil exploration work including carrying out field tests and laboratory tests to evaluate static as well as dynamic parameters of soil/rock and preparation of detailed report including the recommendations regarding founding level, type of foundation for different kinds of structures/machines and methods of deep excavation.

2.00.00 GENERAL

The successful bidder shall perform all work under the purview of this specification along with all incidental and related work including setting out, staging, approach to test locations, successful bidder's office, stores and protection of adjacent buildings, structures or services / facilities. No separate payments shall be made on such accounts. The tenderer should therefore take into account all such relevant items while quoting his bid. The boreholes shall be selected such that all the founding structures including RCC roads and Concrete pavements are represented.

2.01.00 Work to be provided for the successful bidder

The work to be provided by the successful bidder, unless specified otherwise shall include but not be limited to the following.

- a) Furnish necessary plant and equipment, tools and tackles, instruments, necessary power, fuel, water, labour, supervisions by qualified and experienced engineers and supervisors specialised in the type of investigation, transport of materials, men and equipment etc., services, full insurance and all other incidental items as may be necessary for entire and successful completion of the work as per tender terms, drawings, specifications and instruction of the owner / engineer.
- b) Locate in the field and in layout drawing all boreholes and other field investigation items.





- c) Furnish progressively and periodically field bore logs, investigation observations, test results with relevant data and features in triplicate.
- d) Prepare and submit draft (in duplicate) and final (after incorporating comments, if any) sub soil investigation report as per specification and instructions of the owner / his engineer.

2.02.00 **Work to be provided by others**

No work under this specification will be provided by any agency other than the successful bidder unless specifically mentioned elsewhere in the contract.

2.03.00 **Location and Levels**

Location of all boreholes and field test points and levels of the existing ground at such locations shall be established by the successful bidder at his own cost from two reference grids and one bench mark given by the owner/ his engineer and these shall be subsequently plotted in the layout plan, bore logs and other relevant field test data sheets / tables to be incorporated in the report by the successful bidder.

Making bench mark pillar (s) and reference line pillars (whatever are required for the work) and maintaining them upto the completion of the work shall be the responsibility of the successful bidder at no extra cost by the owner.

2.04.00 **Codes and Standards**

The following is the general list of IS Codes to be used for the soil investigation work and preparation of report. In all cases latest revision along with amendments, if any, shall be referred to.

- IS:1498 - Classification and identification of soils for General Engineering purposes.
- IS:1888 - Method of load tests on soils
- IS:1892 - Subsurface investigation for foundation
- IS:1904 - Structural safety of buildings : shallow foundations
- IS:2131 - Method for standard penetration test for soils
- IS:2132 - Code of Practice for thin walled tube sampling of soils
- IS:2720 - Methods of tests for soils
- IS:2809 - Glossary of terms and symbols relating to Soil Engineering.
- IS:2810 - Glossary of terms relating to soil dynamics





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- IS:3025 - Methods of sampling and testing for water used in industry
- IS:3043 - Code of Practice for earthing
- IS:4078 - Indexing and storage of drill cores
- IS:4434 - Code of Practice for insitu vane shear test for soils
- IS:4453 - Code of Practice for exploration by pits, trenches, drifts and shafts
- IS:4464 - Presentation of drilling information and core description in foundation investigation
- IS:4968 (Part-II) - Dynamic Cone Penetration Test.
- IS:4968 (Part-III) - Static Cone Penetration Test.
- IS:5249 - Method of test for determination of dynamic properties of soil.
- IS:5313 - Guide for core drilling observations
- IS:5529 (Part I) - In situ permeability tests - tests in over-burden
- IS:5529 (Part II) - In situ permeability tests - tests in bed rock
- IS:6403 - Determination of allowable bearing pressure on shallow foundations.
- IS:6926 - Diamond core drilling for site investigation for river valley projects.
- IS:6935 - Method of determination of water level in boreholes
- IS:7746 - In situ shear test on rock
- IS:8009 - Calculation of settlement of foundations -
(Part-I) Shallow foundations subjected to symmetrical static vertical loads
(Part-II) Deep foundations subjected to symmetrical static vertical loading.
- IS:8763 - Guide for undisturbed sampling of sands





- IS:8764 - Method for determination of point load strength index of rocks
- IS:9143 - Method for the determination of unconfined compressive strength of rock materials
- IS:9179 - Method for preparation of rock specimen for laboratory testing
- IS:9214 - Method of determination of modulus of subgrade reaction (k-value) of soils in field
- IS:9221 - Method for determination of modulus of elasticity and poisson's ratio of rock materials in uniaxial compression.
- IS:9259 - Liquid limit apparatus for soils
- IS:9640 - Specification for split spoon sampler
- IS:10108 - Sampling of soils by thin wall samples with stationary piston
- IS:10589 - Equipment for subsurface sounding of soils
- IS:10837 - Specification of moulds for determination of relative density and its accessories
- IS:11229 - Specification for shear box testing of soils
- IS:11315 (Part II) - Description of discontinuities in rock mass - core recovery and rock quality

3.00.00 SOIL EXPLORATION

3.01.00 Test Boring

Test Boring through different layers of soil shall be carried out by the successful bidder at the locations which will be marked by the successful bidder based on the approved plot plan and/or at such other locations as directed by the Engineer-in-charge.

Various methods of boring as described in IS: 1892 may be adopted. The tenderer shall furnish the complete details of the equipment and the method he proposes to follow. Minimum diameter of boring shall be 150 mm.

During the boring operations if rock strata is not encountered, the boring shall be continued upto 30 m depth for two bore holes and upto 20m depth for the remaining boreholes unless stated otherwise. In case rock strata is





encountered within the above depths, boring operations shall be discontinued and drilling operation as enumerated in clause 4.0 below shall be resorted to. If the present formation level is above the natural ground with filled-up soil, the depth of boring mentioned above shall exclude such filled-up soil.

The successful bidder shall describe in detail the equipment and method of boring he proposes to use. In the absence of dry boring equipment, wash boring at the discretion of the Engineer may be allowed, but the particular way of cleaning the casing by washing has to be approved by the Engineer. However, if the engineer, at any time, feels that the washing process is disturbing the samples to be taken, he may stop the work and the successful bidder shall have no claim whatsoever on this score. If the successful bidder can, however, improve the method to the satisfaction of the Engineer, he may be allowed to resume the wash boring work.

When boring cannot be advanced due to presence of hard material, it should be checked whether there is continuous strata of hard material below before resorting to drilling methods. If only a local boulder is present it should be chopped using suitable chopping bits and the debris removed and normal boring continued.

Ground water level for each bore hole shall be checked during boring operation and shall be recorded in bore log. Sub-soil water samples shall also be collected from each borehole and recorded.

Where possible, completed boreholes shall be capped and a G.I. pipe inserted in order to preserve them for future ground water level observation. The successful bidder shall use his own materials for this and the scope shall be inclusive of the same. These bore holes after completion of observation shall be handed over to the owner in such condition as to enable future observation of ground water possible. The other boreholes not used for observation shall be backfilled by the successful bidder using sand fill as and when directed by the Engineer.

3.02.00 **Stabilization of Boreholes**

Boreholes shall be stabilized, whenever required, against caving of the sides of the drill hole and heaving of the bottom of the hole. especially in cases where the hole is carried below the ground water level, by use of drive pipe or casing or by means of drilling fluids (water or mixtures of water and colloidal, gel forming thixotropic clays such as bentonite), grouting (in rack) or other suitable methods.

3.03.00 **Open Trial Pits**

The open trial pits shall be carried out by successful bidder at the locations which will be marked by the successful bidder based on the approved plot plan and/or at such other locations as directed by the Engineer-in-charge. The present formation level is finished plant level. Hence the depth of trial pits shall be upto a depth of 3.5m below natural ground level or not





below the ground water table or as directed by the Engineer. In no case, the depth shall be extended over 5m. The size of pits shall be 3.0m x 3.0m or as directed by the Engineer. Samples of undisturbed soil shall be obtained preferably at every 1.5m or where a change in strata is noticed.

The successful bidder shall provide a suitable access to the bottom of the pits. Sampling in trial pits shall be done as directed by the engineer. The successful bidder shall include the scope of trial pit with earthwork in excavation, necessary side slope, backfilling and shoring/ sheeting for side protection, if required.

After completion of the test, sampling and visual examination, the pit shall be suitably backfilled as directed by the engineer. Unless otherwise specified, excavated soil shall be used for this purpose.

3.04.00 **NOT USED**

3.05.00 **Rock Drilling**

During boring operation, once rock strata is encountered, the normal method of boring operation as described under clause 3.01.00 earlier shall have to be stopped and drilling operation will be resorted to for determining depth and nature of rock strata, in a manner as described below.

Rotary core drilling technique with continuous core recovery should be adopted for drilling through rock. The tenderer shall furnish the type of coring bit he proposes to use. The behaviour of rock mass is governed more significantly by the nature of fractures in the rock than by the type and hardness of the material composing the rock itself. Hence, good drilling technique should be adopted to obtain an intact sample truly representative of the in-situ material and for achieving highest percentage of recovery possible. Variations in the speed of rotation, the downward pressure on the core barrel, the pressure at which the drilling fluid is introduced into the hole and the length of hole drilled (run length) prior to removal of the core are major items which must be controlled by the driller. In general, coring should be initiated with short runs both because the upper portions of rock masses are commonly highly fractured and also because the elevations at which core losses occur can be more accurately determined. If conditions indicate that it is possible, the length of the runs may be determined by the length of the core barrel.

In zones which are highly fractured or where the barrel continuously becomes blocked it is essential that short runs be used even though this means removal of the entire string of drilling tools every 300 mm or less. Reduced bit pressure should be resorted to when rod vibration or chatter occurs. The pressure under which the drilling fluid should be introduced into the hole will be the minimum to be consistent with adequate removal of cuttings from the hole and proper cooling of the bit. To minimise the erosive action of the drilling fluid on the core and thereby to improve core recovery, double tube core barrels should be used. The casing and core barrel to be used shall be





of designation BX or NX.

During the drilling operation for each bore-hole the successful bidder shall record the rate of sinking of drill rods, ground water table elevations, if any, nature, type and sequence of rock drilled. From the recovered cores the successful bidder shall determine nature of fractures and degree of weathering of rock for each bore hole. The successful bidder shall also note and record any appreciable loss of drilling fluid throughout the entire drilling operations for each bore hole. The successful bidder shall also determine the percentage recovery ratio and rock quality designation from the recovered cores for each stages of core advance and for all the bore-holes. Rock quality designation is defined as the ratio of cumulative lengths of intact pieces of core greater than 10 cm to the length of core advance.

The successful bidder shall furnish all the information mentioned above fully verified and signed by the Engineer at site and submit them in triplicate to the Engineer. (All the field works shall be verified and signed by the Engineer (owner's) at site)

The drilling operation shall be terminated when more than 75% of the core recovery is possible. If core recovery is lower and the nature of rock is weathered, drilling must be continued upto 30m for two bore holes and 20m for the remaining boreholes below the natural ground level.

In addition to the above mentioned points the successful bidder shall also take into consideration the provisions of the latest revisions of the following Codes of Practice :

- a) IS:6926 - Code of practice for diamond core drilling for site investigation for river valley projects (optional).
- b) IS:4078 - Code of Practice for indexing and storage of drill cores.
- c) IS:4464 - Code of Practice for presentation of drilling information and core description in foundation investigation.

3.06.00 Adits and Test shafts

An exploratory adit is a horizontal or near horizontal excavation made by mining methods in rock. The term "test shaft" is used to refer to a vertical excavation, generally in rock and to very deep test pits. These are used for in-situ examination of the nature of the rock and its structural features such as joints, fractures, faults and shear zones. Adits may also be used for insitu tests to determine the modulus of deformation of rock.

3.07.00 Sampling

Bored soil shall be collected continuously during boring to note any change of





strata. Samples of undisturbed soil shall be obtained preferably at every 1.5 m where a change in strata is indicated by the slurry flowing out. In no case shall the depth between successive sampling be more than 3.0 m and a sample shall be obtained on the average for every 2.0 m depth of boring , since it is intended to ascertain the characteristics of the soil at various depths. If, however , there is fair uniformity in the characteristics of the soil for certain depths the engineer may limit the number of samples stipulated above.

3.07.01 Tube Sampling

For obtaining undisturbed samples in its simplest form , an open drive thin wall tube sampler shall be attached to a rod and shall be lowered to the bottom after completely cleaning the borehole bottom by washing. The samplers to be used should have area ratio less than 13 percent and preferably less than 10 percent. The head should have check valve and ports to permit easy escape of drilling fluid or air from the sample tube as the sample enters it.

Sampling will be accomplished by jacking or driving the tube depending on the type of soil to be sampled. Upon completion of the sampling operation the sampler shall be withdrawn from the borehole and the sample of soil carefully taken out. Approximately one inch length of soil is to be removed from each end for identification. If there is any surface water on the sample, this shall be wiped off with soaking paper, all sludge or cuttings from advancement of borehole removed and the sample immediately packed in an airtight, close fitting container marked with respective test bore numbers, elevation at which the sample was taken and other relevant information as per IS:1892. The size of soil test samples shall preferably be 65 mm dia x 200 mm high , but not less than 50 mm dia. x 150 mm high.

Representative / disturbed samples shall also be taken in different strata for visual classification, water content, grain size analysis, Atterberg limits, determination of specific gravity and compaction tests.

3.07.02 Chunk Samples

In cohesive soils, undisturbed samples of regular shapes shall be collected. The samples shall be cut and trimmed to a suitable size (0.3 x 0.3 x 0.3 m). A square area (0.35 x 0.35 m) shall be marked at the centre of the levelled surface at the bottom of the pit. Without disturbing the soil inside the marked area, the soil around this marking shall be carefully removed upto a depth of 0.35 m. The four vertical faces of the soil block protruding at the centre shall be trimmed slowly so that its size reduced to 0.3 x 0.3 m. Wax paper cut to suitable size shall be wrapped uniformly and covered with two layers of thin cloth over all the 5 exposed surfaces of the soil block and sealed properly using molten wax. A firmly constructed wooden box of size 0.35m x 0.35m (internal dimensions) with the top and bottom open shall be placed around the soil block and held in such a manner that its top edge protrudes just above the surface of the block. The space between the soil block and the box shall





be filled uniformly and tightly with moist saw dust. The top surface shall also be covered with saw dust before nailing the wooden lid to cover the box firmly taking care that the soil block is not disturbed. The area of contact between the bottom portion of the block and the ground shall be reduced slowly by removing soil in small quantities using small rods, so that the block can be separated from the ground slowly without disturbance. After inverting the wooden box along with the soil block, the bottom portion shall be trimmed and covered with wax paper, cloth and sealed with molten wax. A wooden lid shall be nailed to the box after providing proper saw dust cushion below it. An arrow mark shall be made on the vertical face of the wooden box to indicate the top surface along with the coordinates and depth of sampling.

3.07.03 **Sampling in rock**

Sampling in rock shall be accomplished during the drilling process by employing double tube core barrels for continuous core recovery. The drilling procedure to be followed should be the one which brings about the highest percent recovery and the exact procedure must be determined in the field.

3.08.00 **Record of Boring**

Detailed chronological record of drilling and sampling operations shall be maintained in the field log and should be submitted to the owner after completion of boring work at site. The final log showing pertinent subsurface information and results of field and laboratory testing should be submitted with the soil report.

The field log should contain at least the following information :

- a) Reference information like project number, title and location, exploration number and location by coordinates, inclination of the boring and if inclined the bearing or azimuth of the dip of the hole, reference level and datum.
- b) Personnel information - name of drilling Bidder, driller and inspecting engineer.
- c) Equipment data - manufacturer's name and model designation.
- d) Sampling and coring information :
 - i) General : Sample type and number, sampler dimension, depth at start and completion of sampling, length of sample, recovery ratio and complete visual description of each sample in "as retrieved" state.
 - ii) Drive samplers : weight and height of drop of hammer and number of blows for each 150 mm penetration.
 - iii) Push samplers : hydraulic pressure and rate of penetration.
 - iv) Soil or rock coring : average rotational speed, down-ward





hydraulic pressure and rate of penetration.

- v) Rock coring : Rock quality designation (R Q D)
- e) Description of material penetrated but not sampled.
- f) Casing information - size, depth at which required, length and depth of bottom of casing; weight and height of drop of hammer and number of blows for each 300 mm of penetration for driven casing, and average rotational speed and downward pressure on casing and average rate of penetration for drilled casing.
- g) Seepage pressure test information-depth and duration of test.
- h) Groundwater information - depth to water surface recorded daily and continued till water level has stabilized.
- l) Artesian pressure information - depth at which encountered, measured head and lime at which each measurement is made.
- j) Elevation of top and bottom of hole and top of rock
- k) Date and time of all operations and delays with reasons.
- l) Miscellaneous information to aid interpretation of sub-surface conditions.
- m) Additional pertinent information.
The final log shall be a condensation of the field log refined on the basis of field and laboratory tests. The final log should present a clear, concise and accurate picture of subsurface conditions to be utilized by the engineer.

4.00.00 PENETRATION TESTS

Penetration tests using various types of equipment as specified shall be conducted to measure the resistance of soil to penetration.

4.01.00 Standard Penetration Test

Standard penetration test (SPT) shall be carried out in accordance with IS: 2131 at every change in strata or at 1.5 m intervals or as directed by the engineer. The successful bidder shall record the number of blows for each 150 mm penetration of the standard split spoon sampler over a depth of 450 mm. The number of blows for the first 150 mm of penetration shall not be considered in evaluating the penetration resistance. Hammer used for driving the sampler rod shall be 65 kg and drops of 750 mm shall be maintained. Records of the test including depth at which driving is initiated and the number of blows for each 150 mm penetrating shall be shown in the field log, the final log shall indicate the actual SPT value (sum of number of blows for





last 300 mm of penetration) at appropriate depths.

4.02.00 **Static Cone Penetration Test**

The test shall be carried out by successful bidder at the locations which will be marked by the successful bidder based on the approved plot plan and/or at such other locations as directed by the Engineer-in-charge.. A steel cone with an apex angle of 60 deg. and overall base diameter of 35.7 mm giving a cross-sectional area of 10 Sq.cm shall be pushed through soil strata through a distance in accordance with the design of the equipment and cone resistance is noted. Thereafter the cone and the friction jacket with 36 mm OD are pushed together for a distance depending upon the design of the cone and the friction jacket assembly and combined values of cone and friction resistance noted. The procedure shall be repeated upto the desired depth. Rate of penetration shall be 1 cm/sec approximately so as to advance the cone only to a depth which is possible with the cone assembly available.

The driving mechanism shall have a capacity of not less than 10 tonne for the mechanically operated equipment. If approved by the Engineer, manually operated equipment may be used for shallow depths (Not greater than 10 m) in case of soft clay layer.

The successful bidder shall get the dial and pressure gauges calibrated by an approved testing laboratory before commencing the actual test and produce the test certificates to the Engineer.

The test shall be carried out in accordance with IS:4968 (Part-III), latest edition. Cone resistance and frictional resistance shall be separately provided in the report together with a borehole log.

4.03.00 **Dynamic Cone Penetration Test**

Dynamic cone penetration test shall be conducted to predict stratification, density, bearing capacity etc. of soils. The test shall be conducted by driving a standard size cone attached to the bottom of a string of drill rods. The test shall be conducted upto the specified depth or terminated earlier if the number of blows exceeds 35 for 100 mm penetration when the cone is driven dry and 20 for 100 mm penetration when the cone is penetrated by circulating bentonite, in order to avoid damage to the equipment.

The specification for the equipment and accessories for performing this test, test procedure, field observations and reporting or results shall conform to IS:4968 Part – II, the driving system shall comprise of a 65 kg. drive mass having a free fall of 0.75m. The cone shall be of 62.5 mm diameter provided with vents for continuous flow of bentonite slurry through the cane and rods in order to avoid friction between the rods and soil. The use of bentonite slurry may not be necessary when the investigation required is upto a depth of 6m only. On completion of the test, the results shall be presented as a continuous record of the number of blows required for every 300 mm penetration of the cone into the soil in a suitable chart supplemented by a graphical plot of blow





count for 300 mm penetration vs. depth.

5.00.00 GROUND WATER INVESTIGATION

Groundwater investigation shall comprise determination of groundwater levels and pressures and permeability of subsurface materials. The effect of tidal variations (if applicable for the site) on ground water level shall also be observed by noting the water level in boreholes during high and low tide periods.

5.01.00 Ground water level observation

The successful bidder shall make necessary arrangements to prepare the boreholes for ground water observation. Completed boreholes should be capped and a G.I. pipe inserted in order to preserve them for future ground water observation. These observations will be taken by the successful bidder during the period of investigation. At the end of the site investigation work , these boreholes shall be handed over to the owner in such a condition that further observations can be taken by the owner for a period of at least a year.

Piezometers will have to be installed in boreholes as directed by the owner. A piezometer consisting of either a simple standpipe of PVC tubing with a slotted end and surrounded by granular filter of plastic fabrics shall be used for granular soils or permeable rocks. In impermeable soils, hydraulic piezometer consisting of a porous element connected by twin small-bore plastic tubing to a remote reading station will be used.

5.02.00 In-Situ Permeability Test

In-situ permeability test shall be performed in the boreholes specified and/or at such other locations at specified depths as directed by the Engineer for determination of the permeability co-efficient of the soil. The type of test shall be either pump-in or pump-out test depending on the sub-soil and ground water conditions. Pump-in test shall be conducted whether ground water in the borehole exists or not. Pump-out test with piezometer installations shall be conducted to obtain data for dewatering purposes when ground water is met in the borehole.

The specification for the equipment required for the test and the procedure of testing shall be in accordance with IS:5529, Part-I. The successful bidder shall provide all necessary equipment (diesel operated). When it is required to carry out the permeability test for a particular section of the soil strata above the ground water table, bentonite slurry shall not be used while boring.

5.02.01 Pump - in Test

Pump-in test shall be conducted in the borehole/trial pit by allowing water to percolate into the soil. Choice of the method of testing shall depend on the soil permeability and prevailing ground water level. Only clear water shall be





used for conducting the test. Before conducting the test, the bore hole shall be cleaned. Water shall be allowed to percolate through the test section for sufficient period of time to saturate the soil before starting the observation.

a) **Constant Head Method (in borehole)**

This test shall be conducted in boreholes where soils have a high permeability. Water shall be allowed into the bore hole through a metering system ensuring gravity flow at constant head so as to maintain a steady water level in the bore hole. A reference mark shall be made at a convenient level which can be easily seen in the casing pipe to note down the fluctuations of water level. The fluctuations shall be counteracted by varying the quantity of water flowing into the bore hole. The elevation of water shall be observed at every 5 minute interval. When three consecutive readings show constant level of water surface above test depth, diameter of casing pipe, etc. shall be noted and recorded as per the proforma recommended in IS : 5529, Part-I, Appendix-A.

b) **Falling Head Method (in borehole)**

This method shall be adopted for soils of low permeability and which can stand without casing. The test section shall be sealed by the bottom of the boreholes and a packer at the top of test section. If the test has to be conducted at an intermediate section of pre-bored hole then, double packers shall be used. Access to the test section through the packer shall be by means of a pipe which shall extend to above the ground level. Water shall be filled into the pipe upto the level marked just below the top of the pipe and water allowed to drain into the test section. The water level in the pipe shall be recorded at regular intervals as mentioned in IS: 5529, Part-I, Appendix-B. The test shall be repeated till constant records of water level are achieved.

c) **Percolation test (in trial pit)**

Percolation test shall be conducted in the trial pit in areas where effluent is stored / discharged in ground level tanks. The loss of water due to percolation into the soil shall be estimated by the soil absorption capacity. This test shall be conducted in trial pits as per the procedure given in IS: 2470-Part-I, Appendix-A.

5.02.02

Pump - Out Test

This test shall be adopted to determine accurate values of permeability of soil below water table. Observation pipes of 50 mm dia shall be installed at regular intervals along three radial lines extending from the borehole at 120 degrees to each other. Length of these pipes shall depend on the ground level and estimated lowering of the ground water table. The test shall be carried out by pumping out the water to a known depth and recording the water levels in the observation pipes at regular intervals of time till the water





level is stabilized. The observations shall be recorded as specified in IS : 5529, Part-I, Appendix-D.

6.00.00 FIELD TESTS

In situ tests shall be performed as desired by the engineer to measure properties of soil during the field investigation work.

6.01.00 Menard Pressure meter test

This test shall be carried out as per clause 3.7 of IS:1892 in the bore holes specified and/or at such other locations as directed by the Engineer to the full depth of bore holes, to assess the co-efficient of earth pressure at rest and the stress-strain modulus of soil. The tests shall be carried out at every 3.0 m intervals.

The successful bidder will submit, for approval of the Engineer detailed arrangement drawings for the tests including the detail of the equipment he proposes to use and satisfy the Engineer about its adequacy. The successful bidder shall also check and confirm whether the equipment he proposes to use will be suitable for carrying out this test in bore holes of size specified under clause 3.01.00 of this section. If not, separate bore holes of suitable diameter shall be made at locations approved by Engineer for conducting this test.

6.02.00 Direct Load Tests on Soils

The direct load tests on soil shall be carried out in the trial pits specified and/or at such other locations as directed by the Engineer. This test is to be carried out at 2.5m/3.5m below the natural ground level as directed by the Engineer. The plate sizes to be used shall depend on the nature of the soil, a 45 cm square plate will be used in clayey soil and in sandy soils, three plates of size varying between 30 cm to 75 cm will be used. The test shall be carried out in a manner as to give dependable assessment of bearing capacities of the soils at particular level. The results of the test shall also be used for arriving at the modulus of sub-grade reaction and deformation modulus of soil.

The excavation and side protection during the test and back- filling after the test shall be carried out by the successful bidder. If ground water table is at a depth higher than the specified test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. The cost of dewatering shall be borne by the successful bidder.

The successful bidder will submit, for approval of the Engineer, a detailed arrangement drawing for the tests and satisfy the Engineer about its adequacy in respect of strength and safety and of its being capable of giving accurate data. However, the successful bidder shall have to modify the arrangement at his own cost if it is ultimately found to be deficient.





The successful bidder must get the dial and pressure gauges calibrated by an approved testing laboratory before commencing the direct load tests at the site and produce the certificates of the tests to the Engineer. There shall be adequate number of standby gauges available at the site for quick replacement of faulty gauges. The successful bidder shall bring not less than two dial gauges and one pressure gauge as standby.

In no case settlement observations by means of level and staff shall be accepted.

The tests shall be carried out as described in IS:1888 unless otherwise specifically directed. The application of load may be by gravity or by reaction as detailed out in the above standard.

The test plate shall be preloaded with a load of 700 Kg/ sq.m. retained for a reasonable period and then replaced to take out all slacks of the arrangement. All settlement observations shall start thereafter. Unless the ultimate bearing capacity can be calculated from the available soil data, the successful bidder shall assess ultimate bearing capacity of the soil under test. Increments of the load shall be of about one fifth of the ultimate bearing capacity. The increments shall continue to an extent that allows locating the 'Yield Value of the Soil' as defined in IS:1888 or upto practicable limit of testing.

While releasing the loads, the rebounds are to be observed in a similar manner as the settlement observations.

The observations shall be recorded directly in log books, proforma of which has to be approved by the Engineer, who shall also be present to check the data. The Engineer shall be notified well in advance of the detailed programme of the test and shall also be informed prior to start of releasing the load so that the total settlement can be checked by him.

In addition to carrying out plate load tests, undisturbed/disturbed soil samples shall also be collected at regular intervals during excavation.

Each test shall include all costs inclusive of earthwork in excavation upto 3.5m depth below natural ground level, shoring for side protection, if necessary, and back filling after the test. For the depths over 3.5m shall also be considered by the bidder if the site condition warrants. If water table is required to be lowered during the test, necessary diesel operated pumping arrangement will have to be provided by the successful bidder himself.

6.03.00

Vane Shear Tests

Vane shear test shall be conducted for measuring the strength of soft clay in-situ at all depths from the surface to at least 30m and at locations as specified. The test shall be conducted by pushing into the clay a small four-bladed vane of suitable size (75mm or 100 mm diameter depending upon





the soil condition), attached to the end of a rod and then measuring the maximum torque necessary to cause rotation. This torque is a measure of the moment developed by the shear strength of the clay acting over the surface of the cylinder.

The test can be performed at desired depths either inside boreholes or by direct penetration from ground surface. If cuttings at the test depth in the bore hole show any presence of gravel, sand, shells, decomposed wood etc., which are likely to influence the test results, the test at that particular depth may be omitted with the permission of the engineer.

The specification for the equipment and accessories required for performing this test procedure, field observations and reporting of results shall conform to IS:4434.

6.04.00 **Determination of Dry-Density of Soils**

In place dry density of soil is required for assessment of bearing capacity of soils analysis for stability of natural slopes and in settlement calculations for estimating overburden pressure at different depths. The following methods depending on the scope of application in different types of soils shall be adopted as directed by the engineer for determination of in-place dry density of soils.

6.04.01 **Sand Replacement Method**

This method is suitable for fine, medium and coarse grained soils. Small sand pouring cylinder should be used when the soil consists of fine to medium size grains while for soils containing stones where difficulties would be encountered with this method, a large sand pouring cylinder should be used. The sand used for filling shall be clean, uniformly graded natural sand, passing 1.00 mm IS sieve and retained on 600 micron IS sieve. It shall be free from organic matter, oven dried and stored for suitable period to allow its water content to reach equilibrium with atmospheric humidity.

Equipment and accessories, test procedure, observations and reporting of results shall conform to IS: 2720 (Part XXVIII).

6.04.02 **Core-cutter Method**

The specification for this test shall be as per IS:2720 (Part XXIX). The method should be applied for fine grained soil, free from aggregates. Fine grained soils for the purpose of application of this method is defined as soil with not less than 90 percent passing 4.75 mm IS sieve.

6.04.03 **Ring and Water Replacement Method**

The specification for equipment, test procedure, observation and reporting of results for this test shall conform to IS:2720 (Part XXXIII). The test equipment shall consist of a circular ring placed at the surface of the ground and plastic





film inserted in the hole to retain the water. The method should be applied in coarse grained soils including gravels, cobbles, boulders and rock. Density can be determined for either the total material or material smaller than specified or given size.

6.04.04 **Rubber balloon Method**

The equipment, testing method, observations and reporting of results shall be as per IS:2720 (Part XXXIV). This method should be applied for firmly bonded soils, it is unsuitable for very soft soils which will deform under slight pressure or in which the volume of the hole cannot be maintained at a constant value.

6.05.00 **In-situ Block Shear / Wedge Shear Test**

The test shall be carried out in a manner as to give a dependable assessment of shear resistance of rock, when at a shallow depth, rock is encountered.

The test in the trial pits shall be carried out by successful bidder at the locations which will be marked by the successful bidder based on the approved plot plan and/or at such other locations as directed by the Engineer-in-charge. The interpretation of test data and report shall be as per the provisions of IS:7746. The set up without an arrangement for direct application of normal load as detailed in the above standard shall be followed.

Regarding the approval of detailed arrangement drawings for the test, adequacy of conducted test, dial gauges to be used for the test and recording of observations for the test the provisions as laid down for direct load tests on soils shall hold good.

6.06.00 **Test for Measurement of soil Resistivity**

For designing the earthing system for the project it is necessary to find out the electric resistivity of the soil at some representative locations of the project site.

Soil resistivity is determined in Ohmmeter by using "WENNER's FOUR ELECTRODE METHOD". The principle of the above method is generally as under :

Four electrodes are driven into the earth along a straight line at equal intervals of 'S'. This distance 'S' can be varied and different readings taken for electrode spacing $S = 5, 10, 15, 20$ metres etc. to detect the vertical variations of resistivity at a certain location. A current I is passed through the two outer electrodes and the earth. The voltage difference, V , between the two inner electrodes is measured. The current I flowing into the earth produces an electric field proportional to its density and to the resistivity of the soil. The voltage V measured between the inner electrodes is, therefore, proportional to this field. Consequently, the resistivity will be proportional to the ratio of voltage to current.





If the depth of burial of electrodes in the ground is negligible compared to the spacing between the electrodes , then the soil resistivity.

$$= 2 \times 3.14 \times S.V / I$$

Where , Resistivity of soil in Ohm-meter

S = Spacing between electrodes in metre

V = Voltage difference between two inner electrodes in volts.

= Current flowing through two outer electrodes in amp.

Earth testers normally used for the above purpose comprise the current source and meters in a single instrument and directly read the resistance. Such an instrument is known as four terminal meggar. Using such meggar for measurement , above formula becomes

$$= 2 \times 3.14 \times S.R.$$

where R is meggar reading in Ohms.

Depth of burial of electrodes shall not be more than 1/20 or the spacing between the electrodes.

Correction of the test results should be done, if necessary, using the method outlined in IS:3043.

The location and number of the test points are shown in the plant layout. The number shall be increased if the test results obtained in different locations show a significant difference.

7.00.00 TESTS FOR DYNAMIC PROPERTIES

For evaluation of in-situ dynamic and damping properties of soils, Block Vibration Test, Cyclic Plate Load Test and Wave Propagation Test shall be conducted. The triaxial test method using repeated static loading should also be carried out for arriving at the value of the Young's Modulus.

The locations at which such tests are to be carried out as indicated and/or at such locations as directed by the Engineer. If the present formation level is above the natural ground level with filled-up soil, the depth of trial pits shall exclude such filled-up soil.

The tests shall be carried out as described in IS:5249 or IS:1888 as applicable. The successful bidder will submit, for approval of the Engineer, a detailed arrangement drawing for the tests and satisfy the Engineer about its adequacy in respect of strength and safety and of it being capable of giving accurate data. However, the successful bidder shall have to modify the





arrangement at his own cost if it is ultimately found to be deficient.

The observations shall be recorded directly in log books, proforma of which has to be approved by the Engineer, who shall also be present to check the data. The Engineer shall be notified well in advance of the detailed programme of the test and shall also be informed prior to the start of releasing the load so that the total settlement can be checked by him.

The scope shall include earthwork in excavation, shoring for side protection (if necessary) construction/curing of plain concrete test block, supply and embedment of foundation bolts etc. and backfilling after the test.

7.01.00 **Block Vibration Test**

Test pits of size 4.5m x 2.75m at the bottom shall have to be made. Then at the bottom of the pit a Plain Cement Concrete block of grade M15 and of size 1.5m x 0.75m x 0.70m shall be constructed. Suitable foundation bolts shall be embedded in the concrete block during casting for fixing the oscillator assembly. The concrete block shall be cured for a minimum of fifteen days and then the following Block Forced/Free vibration Test shall be carried out as per the recommendations of IS:5249 :

- a) Vertical Vibration Test
- b) Longitudinal Horizontal Vibration Test
- c) Free Vertical Vibration Test
- d) Horizontal Free Vibration Test.

7.02.00 **Wave Propagation Test**

The wave propagation test for determination of shear modulus shall be conducted both by exciting the block to steady state vibrations in the vertical direction and by making seismic waves to pass through the ground by impact of hammer and determining the time of travel of these waves between two points at a known distance apart.

7.03.00 **Cyclic Plate Load Test**

The test shall be carried out in a manner as to give a dependable assessment of load-deformation characteristics within the soil mass.

The provisions of IS: 1888 shall be followed for conducting the test. The application of load may be by gravity or by reaction as detailed out in the above Standard.

The successful bidder must get the dial gauges and pressure gauges calibrated by an approved testing laboratory before commencing the test at site and produce the certificates of the test to the Engineer. There shall be adequate number of standby gauges available at the site for quick





replacement of faulty gauges. The successful bidder shall bring not less than two dial gauges and one pressure gauge as standby.

The successful bidder shall provide a layer of cement-sand mortar (1:1 mix) below the bearing plate to level-off any uneven parts and interstices on the rock surface. Also to achieve a uniform distribution of pressure over the loaded surface, the successful bidder shall provide a flexible layer in the form of rubber pad over the loaded surface.

For conducting the load test the successful bidder shall apply cyclic loading and unloading, with four or five cycles, increasing in successive of 20% to 25% of full load. While releasing the loads the rebounds to be observed in a similar manner as the settlement observations. The range of cyclic loading shall be decided only after the static net bearing capacity is established by conventional plate load tests.

8.00.00 FIELD DETERMINATION OF CALIFORNIA BEARING RATIO

The test shall be carried out by successful bidder at the locations which will be marked by the successful bidder based on the approved plot plan and/or at such other locations as directed by the Engineer-in-charge. The test shall be carried out at a depth of 500 mm below the finished ground level.

The successful bidder shall submit, for approval of the Engineer complete detail of the equipment and the method he proposes to use. However, the successful bidder shall have to modify the arrangement at his own cost if it is ultimately found to be deficient.

The surface area to be tested shall be exposed, cleaned of all loose and dried material, levelled and then soaked till saturation with a surcharge weight of 15 kg. After soaking is complete, the test surface shall be drained of all free water and allowed to stand for at least 15 minutes before starting further operations.

The test shall be carried out strictly in accordance with the provisions as laid down in IS:2720 (Part XXXI) latest edition. Surcharge weights of 15 kg including that of the annular weight of 5 kg shall be applied before application of load on the penetration piston. Load shall be applied on the penetration piston such that the penetration is approximately 1.25 mm/min. The load readings shall be recorded at penetrations of 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10.0 and 12.5 mm. The maximum load and penetration shall be recorded if it occurs for a penetration of less than 12.5 mm.

After completion of the test, a sample of soil shall be taken from the point of penetration for moisture content determination. In place density shall also be determined.

From the plot of load penetration curve, after necessary correction, the bearing ratios shall be calculated for penetrations of 2.5 mm and 5 mm. If the



bearing ratio at 2.5 mm penetration is greater than that at 5 mm penetration the former shall be taken as the bearing ratio. If bearing ratio at 2.5 mm penetration is less than that at 5 mm penetration, the test shall be repeated and if the ratio at 5 mm penetration is consistently greater than that at 2.5 mm penetration, the ratio at 5 mm penetration shall be taken.

9.00.00 LABORATORY TESTS ON SOIL SAMPLES / ROCK CORES

The successful bidder shall carry out the tests as listed out as decided by the Engineer, in laboratory. He shall furnish the name/s of laboratories where he proposes to have the tests carried out and have them approved by the Engineer.

The owner shall have the right of access to successful bidder's laboratory and/or any other laboratory where tests have been arranged to be carried out during the progress of this investigation.

Adequate volume of test samples of soil/rock cores shall have to be collected from site and stored, labelled and transported carefully to the approved laboratory for carrying out the tests. The method and procedure of testing to be followed shall be as per the relevant Indian Standard Codes of Practice. The results of the tests shall be submitted to the Engineer in sextuplicate duly signed by the laboratory- in-charge. In tests for rock cores L/D = 1.0 of samples must be maintained.

10.00.00 REPORT ON SUB-SOIL INVESTIGATION

This specification covers furnishing, installation, repairing, finishing, curing, protection, maintenance and handing over of masonry and allied works for use in structures and locations covered under the scope of the Contract.

10.01.00 General

- a) On completion of all the field (all the field works shall be certified by the owner) and laboratory work, the successful bidder shall submit a formal report containing geological information of the region, procedure adopted for investigation, field observations, summarised test data, conclusion and recommendations. The report shall include detailed borelogs, subsoil sections, field test results, laboratory observations and test results both in tabular as well as graphical form, practical and theoretical considerations for the interpretation of test results, the supporting calculation for the conclusions drawn etc. Initially, the successful bidder shall submit ---- copies of the report in draft form for the owner's review.
- b) The successful bidder's qualified geotechnical engineer shall visit the owner's corporate office for a detailed discussion on the owner's comments on his draft report. During the discussions, it shall be decided as to the modifications that need to be done in the draft





report. Thereafter the successful bidder shall incorporate in his report the agreed modifications and after getting the amended draft report approved, ----- copies of the detailed final report shall be submitted along with one set of reproducibles of the graphs, tables, etc.

- c) The detailed final report based on field observations, in-situ and laboratory tests shall encompass theoretical as well as practical considerations for foundations for different type of structures envisaged in the area under investigations. The successful bidder shall acquaint himself about the type of structures, foundations loads and other information required from the Engineer.

10.02.00 **Data to be furnished**

The report shall include the enlisted items but not be limited to them.

- a) Purpose and scope of investigation
b) Authorization enabling the successful bidder to carry out the work at the site.
c) Project description including proposed facilities and construction materials required for the works.
d) Description of the site which shall include :
i) Location of the site and existing facilities.
ii) Topography of the site
iii) Drainage Characteristics
e) A plot plan showing the locations and reduced levels of all field tests e.g., boreholes, trial pits, static cone penetration tests, dynamic cone penetration tests, plate load tests etc., properly drawn to scale and dimensioned with reference to the established grid lines.
f) A true cross section of all individual bore holes and trial pits with reduced levels and coordinates showing the classification and thickness of individual stratum, position of ground water table, various in-situ tests conducted and samples collected at different depths and the rock stratum, if met with.
g) A set of longitudinal and transverse profiles connecting various boreholes shall be presented in order to give a clear picture of the site, how soil/rock strata is varying vertically and horizontally.
h) Geological information
i) Regional geology - geologic province, topographic position of site, processes of formation of subsurface materials at site.





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- ii) Description of overburden and bedrock at the site (if applicable for the site)
- iii) Comments on texture and structure of rock, joints, bedding planes, fissures, weathering condition etc (of applicable for the site)
- iv) Effect of geologic features on design.
- i) Past observations and historical data, if available, for the area or for other areas with similar profile or for similar structures in the nearby area.
- j) Bore hole & trial pit logs on standard proforma showing the depths, extent of various soil strata etc.
- k) Plot of SPT (N) value (both uncorrected and corrected) with depth.
- l) Procedure of investigations employed - field tests and laboratory investigation.
- m) Results of all laboratory test summarised (i) for each sample as well as (ii) for each layer along with all the relevant charts, tables, graphs, figures, supporting calculations, conclusions and photographs of representative rock cores.
- n) For all triaxial shear tests stress vs. strain diagrams as well as Mohr's circle envelopes shall be furnished. If back pressure is applied for saturation, the magnitude of the same shall be indicated. The value of modulus of elasticity E shall be furnished for all tests along with relevant calculations.
- o) For all consolidation tests, the following curves shall be furnished :
e vs. log p
e vs. p and
compression vs. log t or
Compression vs. square root of t (depending upon the shape of the plot for proper determination of co-efficient of consolidation).

The point showing the initial conditions (e, P) of the soil shall be marked on the curves.
- p) The procedure adopted for calculating the compression index from the field curve and settlement of soil strata shall be clearly specified. The time required for 50% and 90% primary consolidation along with secondary settlements, if significant, shall also be calculated.
- q) For pressure meter tests, the following curves shall be furnished :





Field pressure meter, creep and air calibration curves indicating P_o , P_f and P_1 .

Corrected pressure meter and creep curves indicating $P'o$, $P'f$ & $P'1$.

- r) From the pressure meter test results the value of cohesion, angle of internal friction, pressure meter modulus, shear modulus and coefficient of subgrade reaction shall be furnished along with sample calculation. Calculation for allowable bearing pressures and corresponding total settlements, for shallow foundations mentioned below and capacity calculation of piles in various modes shall also be included.

10.03.00 Recommendations

Recommendations shall be given area wise duly considering the type of soil, structure and foundation in the area. The recommendations shall include but not be limited to the following:

- a) Type of foundations to be adopted for various structures, duly considering the sub soil characteristics, water table, total settlements permissible for structures and equipment. Minimum depth and width of foundation shall also be recommended. The provision in relevant IS codes indicated in clause 2.04.00 shall be considered.
- b) If required for shallow foundations, the following shall be indicated with comprehensive supporting calculations:
- i) Net safe allowable bearing pressure for isolated square and continuous strip footings of different sizes at different founding depths below ground level considering both shear failure and settlement criteria, giving reasons for type of shear failure adopted in the calculation.
 - ii) Net safe allowable bearing pressure for mat foundations at different founding depths below ground level considering both shear failure and settlement criteria.
 - iii) Rate and magnitude of settlement expected of the structure.
 - iv) Modulus of subgrade reaction, modulus of elasticity, deformation modulus from plate load test results along with time-settlement and load-settlement curves for the various footing sizes at different founding levels indicated above. The recommended values shall include the effect of size, shape and depth of foundation.
- c) As piling is envisaged, the following shall be indicated with comprehensive supporting calculations:



- i) Type of pile and reasons for recommending the same considering soil characteristics.
 - ii) Suitable founding strata for pile.
 - iii) Estimated length and diameter of pile for various values of pile capacities. End bearing and frictional resistance shall be indicated separately.
 - iv) Magnitude of negative skin friction, if any, to be considered in pile design.
- d) Recommendations on foundations for special structures like tanks, transformers, sub-station structures, conveyor trestles, silo/stack like structures, etc.
- e) Recommendations regarding bases of roads and pavements.

10.04.00 **Additional Recommendations**

- a) Co-efficient of permeability of various sub soil and rock strata based on in-situ permeability tests.
- b) Cone resistance, frictional resistance, total resistance, relation between cone resistance and SPT(N) value and settlement analysis for different footing sizes based on CPT/SPT.
- c) Electricity resistivity of sub-soil based on electrical resistivity tests including electrode spacing vs cumulative resistivity curve.
- d) Evaluation of design parameters for design and analysis based on dynamic parameters of soil like Amplitude vs. Frequency curves, co-efficient of elastic uniform compression and elastic uniform shear of soil, co-efficient of elastic non-uniform compression, co-efficient of elastic non-uniform shear, value of damping co-efficient, elastic and shear modulus of soil and Poisson's ratio of soils.
- e) Co-efficient of earth pressure at rest and stress strain modulus of soil from Menard pressure meter test.
- f) Recommendations regarding earth pressure as a function of depth below grade as applied to side walls of underground structures. Values of co-efficient of permeability shall be included in the report.
- g) Recommendations regarding method and slope of deep excavations.
- h) Recommendations regarding stability of slopes, during excavations, etc.
- i) Potential of rock slides and methods of stabilisation of sides for very steep cut.





- j) If expansive soil is met with recommendation on removal or detainment of the same under the structures/roads etc. shall be given. In the latter case detailed specification of any special treatment required including specification for materials to be used, construction method, equipment to be deployed etc. shall be furnished.
- k) Susceptibility of sub soil strata to liquefaction in the event of earthquake and recommendation on remedial measures, if necessary.
- l) Information of special significance like dewatering schemes etc. which may have a bearing on design and construction.
- m) Aggressiveness of percolating water through sub-soil/ rock fissures to reinforced concrete foundation/sub- structures and also recommended protective measures, if required.
- n) Recommendation for the type of cement to be used and any treatment to the underground concrete structures based on the chemical composition of soil and sub-soil water.
- o) Recommendation on suitability of the overburden soil as material of construction of earthen embankments and in back filling of excavated pits / trenches.
- p) Recommendation on the use of rock available as construction material.
- q) Recommendation on the availability of material for use as aggregates at the site.
- r) Recommendation for additional investigation beyond the scope of the present work if the successful bidder considers it necessary.
- s) **Plates**
 - i) General plan showing location of site, and areal geology.
 - ii) Plan showing existing features, proposed facilities, contours and locations of boring and other investigations.
 - iii) Geologic sections and soil profiles.
- t) **Appendices**
 - i) Logs of subsurface explorations
 - ii) Field test results
 - iii) Laboratory test results



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for
Chimney

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VOLUME: II-B

SECTION: I

PART: A

SUB SECTION: II

**GUIDELINE
FOR
AREA GRADING**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part A; Sub Section: II
Area Grading



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for
Chimney**

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**VOLUME: II-B
SECTION: I**

PART: A

SUB SECTION: II

**GUIDELINE
FOR
AREA GRADING**

1.00.00 SCOPE

This specification shall govern all clearing, grubbing, excavating, area filling, grading and compacting soils for areas designated on the drawings. The work shall include clearing and grubbing, stripping and storage of top soil, excavation, , hauling, dumping and spreading of soil, undercutting to remove unstable soil areas, compacting existing soil surfaces and bottom of excavated areas to receive fills, compacting excavated areas for sub-grade, placing and compacting soils in fills, dealing with surface water, pumping to keep excavated areas and areas to be filled dry, final grading of designated areas, disposing of unsuitable and excess excavated materials and incidentals thereof.

Since the work is to be carried out within the existing plant premises, dismantling of any existing structures as instructed by the owner, clearing and disposal of debris outside the plant premises and stacking the useful materials within the plant boundary in locations as directed by the owner included in this scope. Also care shall be taken, activities of this project shall not affect the nearby structures of the existing plant and necessary protection mechanism may be done if warranted by the successful bidder without any price implication to the owner.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Successful bidder

Generally the area is graded since it is within the existing plant. However if Necessary site leveling & Area Grading works of the Chimney package area including final micro leveling and dismantling of any paving is to be done by the successful Bidder.

The work to be provided for by the Successful bidder, unless specified otherwise, shall include but not be limited to the followings:

- a) Furnish all labour, supervision, services, earth-moving machineries and equipment, compaction plant and equipment, tools and plants, survey instruments, transportation etc. required for the work.





- b) Prepare and submit working drawings showing the approaches, slopes, berms, sumps for dewatering, space for temporary stacking of spoils, disposal area, borrow pits, fencing etc. and all other details as may be required by the Engineer.
- c) To carry out and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction.

2.02.00 **Work to be provided for by others**

No work under this specification will be provided by any agency other than the Successful bidder unless specifically mentioned elsewhere in the Contract.

2.03.00 **Codes and Standards**

All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed:

IS : 1200	:	Method of Measurement of Building and Civil Engineering work, Part-I Earthwork
IS : 2720 (Part-II)	:	Determination of Moisture Content
IS : 2720 (Part-IV)	:	Grain Size Analysis
IS : 2720 (Part-VII)	:	Determination of Moisture Content/Dry
IS : 2720 (Part-VIII)	:	Determination of Moisture Content/Dry
IS : 2720 (Part-XIV)	:	Determination of Density Index (Relative
IS : 2720 (Part-XXIV)	:	Determination of Dry Density, in place,
IS : 2720 (Part-XXVIII)	:	Determination of Dry Density of Soils,
IS : 3764	:	Safety Code for Excavation Work





- IS : 4081 : Blasting and related drilling operations
- IRC : SP-11 : Hand book of quality control for construction of roads and runways
- IRC : 36 : Construction of Earth Embankments for Road Work

2.04.00 **Conformity with Designs**

The Successful bidder shall carry out the work as per the drawings issued to him and/or Successful bidder's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.05.00 **Materials to be used**

2.05.01 General

All materials required for the work shall be of best commercial variety and as approved by the Owner.

2.05.02 Borrow Material(If required)

Borrow material if required for area filling shall be excavated from approved locations shown within 25KM and levels, and shall consist of selected material, approved by the Owner, free from roots, vegetation, decayed organic matter, harmful salts and chemicals, free from lumps and clods. Clean graded sand, free from harmful and deleterious materials from approved quarries, shall be used as fill material at places approved during detail Engineeringstage.

Necessary arrangement shall be done by the SuccessfulBidder for locating and using the borrow areas after approval as the source of supply of filling material.

The depth of borrow pits should be so regulated that the borrow pits do not cut an imaginary line having a slope of 1 vertical in 4 horizontal projected from the edge of final section of the adjacent embankment of stack of excavated soil.

2.06.00 Quality Control

The SuccessfulBidder shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work:

- a) Lines, Levels and Grades: i) Periodic Surveys





- ii) Establishment of markers, Boards etc.
- iii) Checking levels and slopes of the graded surface.
- b) Area filling :
 - i) Checking the quality of fill material
 - ii) Checking moisture content of the fill.
 - iii) Checking the degree of compaction.

2.06.01 Any work which fails to conform to the specifications shall be subject to the issue of a Non-conformance Report in line with the Quality Control Procedure to be implemented at site. Corrective or remedial action, design modifications or product rejection shall be reviewed in accordance with the site Quality Plan.

3.00.00 EXECUTION

3.01.00 General

The work shall be undertaken in accordance with the lines, levels, grades and details shown on the drawings, specification and the approved method of work.

The works shall be carried out in a workman like manner without endangering the safety of nearby structures, roads, cable, pipelines, drains, trenches, etc. and without causing hindrance to construction activities.

Suitable approaches, fencing, area lighting and temporary works required for the works shall be provided by the SuccessfulBidder. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where damping from a high bench is in progress, if directed by the Owner. Adequate area lighting shall be provided by the SuccessfulBidder, if night work is undertaken.

The SuccessfulBidder shall submit a proposal covering the proposed excavation and placement of fill material for approval of the Owner. The proposal shall include but not be limited to the following.

- a) Mobilization and demobilization of plant
- b) Proposed plant and equipment, labour resources & supervision.





- c) Details of proposed method of clearing and grubbing for each area of cut and fill.
- d) Drawings showing the areas for placement of material.
- e) Management of excavation and filling works i.e., control of setting out, testing procedures, handling, temporary stockpiles, etc.
- f) Temporary works proposals
- g) Excavation, filling and compaction by mechanical plant
- h) Dealing with surface water
- i) Dewatering
- j) Disposal of materials
- k) Safety precautions, fencing and lighting
- l) Calculations as appropriate to support work proposal

3.02.00 Setting Out

The Successful Bidders shall prepare and submit to the Owner/Consultant, detailed drawings of the excavation and filling work necessary, as proposed to be executed by him, showing the dimensions as per drawings and specification, adding his proposals for slopes, approaches, dewatering sumps, berms etc. On receiving the approval from the Owner/Consultant with modifications and corrections if necessary, the Successful Bidders shall set out the work from the control points furnished by the Owner and fix permanent points and markers for future checking. These permanent points and markers shall be checked by the Owner and certified by him after which the Successful Bidders shall proceed with the work. It should be noted that this checking by the Owner prior to start of the work shall in no way absolve the Successful Bidder of his responsibility of carrying out the work to true lines, levels and grades as per drawing and subsequent corrections, if any. In case any errors are noticed in the Successful Bidder's work at any stage, the same shall be remedied by the Successful Bidder.

3.03.00 Initial Levels

Initial levels either in a definite grid pattern or as directed by the Owner shall be taken by the Successful Bidder jointly with the Owner over the original ground prior to starting actual grading work and after setting out these initial levels and cross-sections shall be jointly signed by the Successful Bidder and the Owner before commencement of work.

3.04.00 Clearing and Grubbing etc.





The area to be excavated or filled shall be cleared out of fences, rubbish, slush, etc. and levelled up.

Before grading is started, all the spoils and unserviceable materials and rubbish shall be removed from the site to approved disposal areas within a lead of 10KM as may be specified. Useful materials, saleable timber, firewood, steel scrap, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Owner.

3.05.00

Classification

Materials involved in grading shall be classified under the following categories. No distinction will be made whether the material is dry or wet. The Engineer's decision in regard to such classification shall be final and binding on the Successful bidder:

a) **Ordinary and hard soil**

This shall include clay, silt, sand, moorum, shingle, kankar, gravel, loam, peat, ash and other similar materials in soft, hard or dense state which can generally be excavated with ordinary spade, pick axe, shovel etc. and does not require the use of wedges, pneumatic breaking equipment and/or blasting for removal. It shall also include loose rock boulders present in the soil, with dimensions not exceeding 500 mm in any direction. Breaking of consolidated brick ballast and mud concrete shall be considered equivalent to excavation work under this type of soil.

b) **Soft and Decomposed Rock**

This shall include rocks like chalk, slate, mica schist, laterite and other similar materials which in the opinion of the Engineer is rock, but does not require blasting for removal and could be removed with picks, hammers, crow bars, wedges, pneumatic breaking equipment etc. It shall also include boulders with dimensions greater than 500 mm but not exceeding 1000 mm in any direction. The mere fact that the Successful bidder resorts to blasting for his own convenience shall not mean that the rock will be classified as hard rock.

3.06.00

Earthwork in Excavation

3.06.01

General

Before commencement of excavation/filling the existing ground surface shall be cleared in accordance with Clause no. 3.4.0.

All excavation shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Owner shall be obtained by the Successful Bidder, in each individual case, for the method he proposes to adopt for the excavation including dimension, side slopes, dewatering,





disposal, etc.

This approval, however, shall not in any way make the Owner responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Owner.

The rough excavation may be carried up to a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Owner, soft and undesirable spots shall be removed even below the final level and the same shall be filled with lean PCC (M10) upto the founding level.

3.06.02 **Excavation in Ordinary Soil, Hard Soil & Soft and Decomposed Rock**

The excavation in ordinary soil, hard soil and soft and decomposed rock shall be carried out as per the approved proposal, modified and corrected where necessary by the Owner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures or roads, railway tracks, cables, pipelines, drains, trenches, etc. if any, and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work shall be checked by the Owner thoroughly and the balance work shall be carried out carefully to avoid any over-excavation.

On completion, the work shall be finally checked and approved by the Owner. Further work shall be resumed after getting clearance from the Owner.

3.06.03 **Excavation in Hard Rock**

Overburden, if any, consisting of top soil, ordinary and hard soil, soft and decomposed rock as per classification of soil, which do not require blasting shall be completely stripped off and the levels of the hard rock surface shall be taken to enable measurement. Further work in hard rock shall be resumed after clearance from the Owner.

Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

3.06.04 **Blasting is not permitted since work is to be carried out within the existing running plant.**





3.06.05 Disposal

The excavated spoils shall be disposed off within the specified lead in any or a combination of some of the following manners, as directed by the Owner:

- a) By stacking separately the materials suitable for area filling and materials not suitable.
- b) By stacking it temporarily for use in backfilling at a later date.
- c)
 - i) by either spreading, or
 - ii) Spreading and compacting at designated filling areas and/or disposal areas.

3.06.06 Dewatering

All areas shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Successful Bidder shall remove by pumping or other means approved by the Owner, any water inclusive of rain water and subsoil water accumulated in the area. Method of dewatering shall be got approved by the Owner.

Any special dewatering system like well point dewatering required for lowering the ground water table to facilitate construction work of sub-structure / super structure in a water free condition is in the scope of contractor. Dewatering will be planned and continued till backfilling is completed. For discharge of sub-soil water / rain water, a suitable piping system with pumping arrangement will be provided by the contractor with prior approval of purchaser to the nearby sump/drain i.e. Korappallum back water channel located at western side of plant boundary. Contractor has to deploy dewatering diesel driven pumps/ DG sets of suitable capacity to take care of any exigencies in case of power disruption to the electrical driven dewatering pumps.

3.06.07 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

Working surfaces shall be formed to such falls to shed water and prevent ponding.

No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Successful Bidder may need to construct temporary drainage systems to drain surface





water from working areas.

3.07.00 Treatment of Slips

The Successful Bidder shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond control of the Successful Bidder, the same shall be removed by him.

3.08.00 Earthwork in Filling

3.08.01 Area Filling for Grading

The material to be used for area filling shall be selected material capable of being compacted to the requirements stated herein below and approved by the Owner, obtained directly from excavation for area grading, from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated soils or from borrow pits in selected areas designated/approved by the Owner. The quality of the material shall conform to that mentioned in clause 2.5.2 of this specification.

Where excavated material is mostly rock, the boulders shall be broken into pieces not longer than 150 mm size, mixed with properly graded fine material consisting of murmur or earth to fill up the voids and the mixtures used for filling.

If any material is rejected by the Owner, Successful Bidder shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed of as directed by the Owner within a lead of 5 KM after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Owner. Before commencement of area filling the existing top soil shall be removed up to a minimum depth of 150 mm, or more, as directed by the Owner in order to clear the surface of undesirable materials. After this the filling operation shall be performed with earth in layers not exceeding 300mm, loose thickness. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as given below and got approved by the Owner.

- a) Each layer of earth of cohesive in nature shall be compacted to 90% of proctor's dry density unless otherwise permitted/directed by the Owner.
- b) Each layer of earth of non-cohesive in nature shall be compacted to minimum 75% relative density unless otherwise permitted/directed by the Owner. Each shall be compacted with approved machine





(mechanical plant) and usually manual compaction shall not be allowed unless specifically permitted by the Owner.

The original ground formation and each fill layer shall be compacted by rollers as described below with a maximum of six passes of 8/10 tons roller.

- i) When the optimum moisture content of soil is relatively high, a pneumatic tyred roller (type pressure 3.0 - 3.5 kg/sq.cm) shall be considered to give better performance for mechanical compaction.
- ii) When the optimum moisture content of soil is relatively low, a vibrating roller shall be considered to give better performance for mechanical compaction.

Since the degree of compaction depends on the moisture content of the soil, a close watch shall be kept on this aspect and corrections done to optimize the moisture content. The adequacy of the compaction and moisture content of the soil shall be determined by performing field density tests and other tests as and when directed by the Owner and shall conform to the stipulations laid down in IS:4701.

The cohesion-less soil to be used for area filling, should be placed in fully saturated condition to obtain the maximum possible density. The saturation moisture content shall be determined by laboratory tests prior to commencement of work.

Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed.

When density measurements reveal soft areas in the construction, further compaction shall be undertaken at the Successful Bidder's cost as directed by the Owner/Consultant. If the required compaction is then not achieved the material in the soft area shall be removed and replaced by approved material and compacted in accordance with this specification all to the Successful Bidder's account.

The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill shall be considered as incomplete if the desired compaction has not been obtained.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicate grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken





material and earth shall be laid and consolidation carried out by a 12 tonnes roller. No less than 12 passes of the roller shall be accepted before subsequent similar operations are taken up.

3.08.02 **Filling in Disposal Areas**

Excavated materials if not used in area filling, shall be disposed of in designated disposal areas within a lead of 10KM as directed or as indicated in the drawings. The earth shall not be dumped haphazardly but shall be spread in horizontal layers not exceeding 500 mm in thickness and nominal compaction done to the satisfaction of the Owner.

All clods shall be broken before placing the fill. Earthmoving machinery including dumpers, dozers and trucks shall be allowed to ply over the fill to permit compaction to take place.

In wide areas rollers may be employed and nominal compaction done to the satisfaction of the Owner.

3.09.00 **Compaction Control**

The density of each layer of compacted soil shall be ascertained by testing a number of samples. For this purpose the necessary arrangements for soil testing at the site shall be made by the Successful Bidder in accordance with these specifications and as directed by the Owner.

The Successful Bidder shall arrange the provision of the field laboratory including the testing equipment and a suitable motor vehicle.

All soil testing is to be carried out by a competent and suitable qualified engineering testing firm. The Successful Bidder is to obtain the Owner's/Consultant's approval for the firm to be used. The Successful Bidder may undertake this work with the Owner's approval.

All density testing shall be carried out on a lot by lot basis. A lot shall be considered to be a portion of work which is essentially homogeneous with respect to material type general appearance response during compaction, moisture condition during compaction, compaction process and state of underlying material.

All fill testing shall be carried out in accordance with the recent editions of relevant Indian Standards. The chainage and the off-set from the centre line of the fill of each test sample shall be recorded and presented along with the test results.

Each test lot shall be classified as cohesionless or cohesive. The classification shall be determined by the Owner/Consultant based upon particle size distribution. Cohesionless fill shall have 10% or less by mass of particles finer than 0.075 mm. Otherwise fill shall be treated cohesive.





For cohesionless fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum and minimum dry density. These reference values of dry density shall be used to compute the density index (relative density) of each of the field density test samples taken from the test lot.

For cohesive fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum dry density and optimum moisture content (OMC). These reference values of dry density and moisture content shall be used to compute the dry density ratio of each of the field density test samples taken from that test lot.

The degree of compaction shall be determined by considering the mean density of the samples in each test lot. The mean dry density shall be equal to or exceed the minimum specified density. In no individual case shall density be less than the minimum value specified by more than 2 percent, otherwise further rolling shall be done at the appropriate locations.

The Successful Bidder shall lay a further layer or fill only after compaction of a particular layer has been found and approved by the Owner.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Soil Testing

Tests shall be undertaken by the Successful Bidder as per IS 2720 and as required by the owner. The results and reports shall be submitted to the Owner/Consultant for approval. Test failures if any are to be immediately notified to the Owner/Consultant, otherwise results to be submitted within 24 hours of testing. Each layer of material shall be tested for compaction.

Each layer is to be tested in a manner that is representative of its full depth. The Owner/Consultant may at his discretion instruct the Successful Bidder to increase or decrease the frequency of testing.

4.02.00 Acceptance Criteria

4.02.01 Excavation

On completion of excavation, the dimensions of the area shall be checked as per the drawings after the area is completely dewatered. The work shall be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by lean mix PCC M10. Over excavation of the sides shall be made good by the Successful Bidder. The excavation work shall be accepted after the above requirements are fulfilled & all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.02.02 Area-filling





The degree of compaction required shall be as per the stipulations laid down in appropriate sections of this specification. The actual method for measuring the compaction achieved shall be as decided by the Owner. The work of area filling shall be accepted after the Owner is satisfied with the degree of compaction achieved.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 After Award

Following details of Machineries, transport vehicles, equipment proposed to be used for excavation, area-filling and compaction have to be submitted before starting the work.

- i) Equipment, machinery & earthmoving vehicles, available with the Successful bidder and proposed to be used for excavation and haulage giving details regarding make, model, capacity, year of manufacture, numbers available for this contract and general condition.
- ii) Equipment proposed to be used for area filling and compaction giving similar details as in item 5.1.0 (i) above.
- iii) Method of transportation.

5.02.00 After Award of Contract

After award of contract the Successful Bidder shall submit the following for approval and adoption:

- a) The Successful Bidder shall submit a detailed programme of work as proposed to be executed giving completion dates of excavation of the various areas and the time required for area-filling and compaction. The programme should also show how the excavation and area-filling quantities shall be balanced, minimizing temporary stacking of soils.

It is to be noted that the Owner even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with overall construction schedule without attracting any claims from the Successful Bidder. The initial programme being submitted by the Successful Bidder should have sufficient flexibility to take care of such reasonable variations.

- b) The Successful Bidder shall submit drawings showing details of slopes, approaches, sump pits, dewatering lines, borrow pits, if any, fencing etc. for approval of the Owner/Consultant for adoption.





Tender Specification
for
Chimney

NLC TamilNadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: A

SUB SECTION: III

**GUIDELINE
FOR
EARTHWORK IN EXCAVATION AND BACKFILLING**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part A; Sub Section: III
Earthwork in Excavation and Backfilling



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**VOLUME: II-B
PART-A**

SECTION-III

**GUIDELINE
FOR
EARTHWORK IN EXCAVATION AND BACKFILLING**

1.00.00 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations covered under the scope of this contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Successful Bidder by Chimney Package

The work to be provided for by the Successful Bidder of Chimney Package, unless specified otherwise, shall include but not be limited to the following :

- a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.
- b) Prepare and submit working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of soils, disposal area, fencing, etc. and all other details as may be required by the Owner.
- c) To carry out sampling and testing and submit to the Owner/Consultant, results of soil compaction tests whenever required by the Owner/Consultant to assess the degree of compaction.

2.02.00 Work to be provided for by others

No work under this specification shall be provided by any agency other than the Successful Bidder of Chimney Package unless specifically mentioned elsewhere in the Contract.





2.03.00 Codes and Standards

All works under this specification, unless specified otherwise, shall conform to the latest revision and/or replacement of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Consultant shall be followed :-

IS:2720 (Part-II)	Determination of Moisture Content
IS:2720 (Part-VII)	Determination of Moisture content / Dry Relation using Light Compaction.
IS:2720 (Part-xiv)	Determination of Density Index (Relative Density) of cohesionless soils.
IS:2720 (Part-xxix)	Determination of Dry Density , in place, by core cutter method.
IS:2720 (Part- xxviii)	Determination of Dry Density of soils, in place, by sand replacement methods.
IS:3764	Safety code for Excavation work.
IS:4081	Blasting and Successful Drilling Operations
IS:4701	Earthwork on canals

2.04.00 Conformity with Designs

Successful Bidder of Chimney Package is to carry out the work as per the drawings which are approved by the Consultant and/or the Owner's instructions.

2.05.00 Materials to be used

2.05.01 General

All materials required for the work shall be of best commercial variety and approved by the Owner.

2.05.02 Borrow Material

Borrow material if required for back-filling shall be excavated from approved locations(within a lead of 25KM)and levels, and shall consist of material, approved by the Owner, free from roots, vegetation, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries shall be used as fill material without any additional cost to owner.





2.06.00 **Quality Control**

The Successful Bidder shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work:

- a) Lines, Levels and Grades :
 - i) Periodic surveys
 - ii) Establishment of markers, boards etc.
- b) Back-filling :
 - i) Checking the quality of fill material
 - ii) Checking moisture content of the backfill
 - iii) Checking the degree of compaction

2.07.00 **Information regarding site conditions**

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Successful bidder shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Successful bidder must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.00.00 **EXECUTION**

3.01.00 **Setting Out**

Successful Bidder of Chimney Package shall prepare and submit to the Owner /Consultant, detailed drawings of the excavation work as proposed to be executed by him showing the dimensions as per drawings and specification adding his Proposals of slopes, shorings, approaches, dewatering sumps, berms, etc. On receiving the approval from the Owner /Consultant with modifications and corrections, if necessary, the Successful Bidder shall set out the work from the control points furnished by the Owner and fix permanent points and markers for ease of future checking. Adjacent structures/foundations shall be protected while executing the Chimney construction work.

These permanent points and markers shall be fixed at intervals prescribed and checked by the Owner and certified by him after which the Successful Bidder shall proceed with the work. It should be noted that this checking by the Owner prior to start of the work shall in no way absolve the Successful Bidder of his responsibility of carrying out the work to true lines





and levels and grades as per drawing and subsequent corrections, if necessary, in case any errors are noticed in the SuccessfulBidder's work at any stage.

3.02.00 **Initial Levels**

Initial levels either in a definite grid pattern or as directed by the Owner will be taken by the SuccessfulBidder jointly with the Owner over the original ground prior to starting actual excavation work and after setting out. These initial levels and cross-sections shall be jointly signed by the SuccessfulBidder and the Owner before commencement of work

3.03.00 **Clearing and Grubbing, etc.**

The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and levelled up.

Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to approved disposal areas within a lead of 10KM as may be specified. Ash shall be spread or removed. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Owner.

3.04.00 **Classification**

All earthwork shall be classified under the following categories:

No distinction will be made whether the material is dry or wet.

a) **Ordinary Soil**

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) **Hard Soil**

This shall include:

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;





- iv) macadam surfaces such as water bound, and bitumen/tar bound;
 - v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
 - vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
 - vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.
- c) **Soft and Decomposed Rock**
- This shall include:
- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
 - ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
 - iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
 - iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.
- d) **Hard Rock (requiring blasting)**
- This shall include:
- i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required;
 - ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
 - iii) boulders requiring blasting.
- e) **Hard Rock (blasting prohibited)**





Hard rock requiring blasting as described under (d) above excavation has to be carried out by chiselling, wedging or any other agreed method since blasting is prohibited within the plant premises.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.05.00 **Excavation for Foundations and Trenches**

3.05.01 **General**

All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Owner shall be obtained by the SuccessfulBidder, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however, shall not in any way make the Owner responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

All excavation in open cuts shall be made true to line, slopes and grades shown on the drawing or directed by the Owner. The vertical faces of excavation shall not be undercut for extended footings / foundations. No material shall project within the dimension of minimum excavation lines marked. Boulders projecting out of the excavated surfaces shall be removed, if in the opinion of the Owner they are likely to be a hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Owner /Consultant and the SuccessfulBidder shall ensure the stability and safety of the excavation, adjacent structures, services and works.

The SuccessfulBidder shall have full responsibility of the stability of the excavation and safety of the workmen. If any slip occurs, the SuccessfulBidder shall remove all slipped material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to the area to be excavated as to be liable, in the opinion of the Owner, to fall or otherwise endanger the workmen, equipment of the work, etc., shall be stripped off and removed away from the areas of excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe. Any materials not requiring removal as contemplated in the work, but which, in the opinion of the Owner, is later to become loose or unstable shall also be promptly and satisfactorily removed as directed by the Owner.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Owner.

The rough excavation may be carried up to a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Owner, soft and undesirable spots shall be removed even





below the final level. The extra excavation shall be filled up as instructed by the Owner (with lean PCC M10).

If the excavation is done to a depth greater than that shown on the drawing, or directed by the Owner, due to the Successful Bidder's fault, the excess depth shall be filled up to the required level (with cement concrete not leaner than M10 concrete or richer) as directed by the Owner in each individual case.

Should the bottom of any excavation at design depth appear to be soft, unsound or unstable, the Successful Bidder shall report the matter to the Owner and if the Owner so directs, shall excavate the same to indicated depths. The extra depth shall be filled up with concrete M10 or such other material as the Owner shall direct.

In formation of rock requiring blasting, those overcuts which are unavoidable shall be made up by ordinary cement concrete 1:2:4. All excavated materials such as hard rock, boulders, bricks, dismantled concrete blocks, etc. shall be stacked separately as directed by the Owner and shall be the property of the Owner.

3.05.02 **Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock**

The excavation in ordinary soil, hard soil, soft and decomposed rock shall be carried out as per the approved proposal, modified and corrected where necessary by the Owner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work shall be checked by the Owner thoroughly and the balance work shall be carried out carefully to avoid any over-excavation. On completion, the work shall be finally checked and approved by the Owner. In certain cases, where deterioration of the ground, upheaval, slips, etc. are expected, the Owner may order to suspend the work at any stage and instruct the Successful Bidder to carry out the balance work just before the foundation work of the structure can be started.

3.05.03 **Excavation in Hard Rock**

In case where excavation, both in ordinary soil and hard rock, are involved, the ordinary soil comprising of soft, hard and dense soils (including laterite formations) and rock including weathered rocks, lateritic rocks, etc. which can be excavated without blasting, shall be completely stripped off. Further work in hard rock shall be resumed after clearance from the Owner.

Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres,





steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

As blasting is prohibited, the excavation shall be carried out by chiselling, wedging or any other approved method.

3.05.04 **NOT USED**

3.05.05 **Disposal**

The excavated spoils shall be disposed of in any or all the following manners:

- a) By using it for backfilling straightway.
- b) By stacking it temporarily for use in backfilling at a later date during execution of the Contract.
- c)
 - i) By either spreading or
 - ii) spreading and compacting at designated filling areas and / or disposal areas.
- d) By selecting the useful material and stacking it neatly in areas designated by the Owner for use in backfilling by some other agency.

3.05.06 **Disposal of Surplus**

All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Owner within a lead of 10KM.

All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be the property of the Owner.

3.05.07 **Protection**

The Owner shall be notified by the Successful Bidder as soon as the excavation is expected to be completed within a day so that it may be inspected by him at the earliest. Immediately after approval of the Owner, the excavation must be covered up in the shortest possible time. But, in no case the excavation shall be covered up or worked on before approval by the Owner. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or trench or half the depth of the pit or trench whichever is more or further away if directed by the Owner.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken.

Adequate fencing is to be made enclosing the excavation.





The SuccessfulBidder shall protect all under-ground services exposed by excavation. The SuccessfulBidder shall also divert all surface drains, etc. affected by the excavation to maintain the working area neat and clean. The use of mechanical equipment shall not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. The existing facilities shall be retained either by modifying or relocating as the case may be without any additional cost to owner.

3.05.08 **Dealing with Surface Water**

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the SuccessfulBidder may need to construct temporary drainage systems to drain surface water from working areas.

3.05.09 **Dewatering**

All excavations shall be kept free of water and slush. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The SuccessfulBidder shall remove by pumping or other means approved by the Owner any water inclusive of rain water and subsoil water accumulated in excavation and keeps the trench dewatered until the construction of foundation structure and backfilling are complete in all respects. Sumps made for dewatering must be kept clear of the foundations. Method of pumping shall be approved by the Owner but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping.

Any special dewatering system like well point dewatering required for lowering the ground water table to facilitate construction work of sub-structure / super structure in a water free condition is in the scope of contractor. Dewatering will be planned and continued till backfilling is completed. For discharge of sub-soil water / rain water, a suitable piping system with pumping arrangement will be provided by the contractor with prior approval of purchaser to the nearby sump/drain i.e.Korappallum back water channel located at western side of plant boundary. Contractor has to deploy dewatering diesel driven pumps/ DG sets of suitable capacity to take care of any exigencies in case of power disruption to the electrical driven dewatering pumps.

3.05.10 **Timber Shoring**





Timber Shoring made out of approved quality of timber shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench and the type of timbering shall be determined by the Owner. It shall be the responsibility of the SuccessfulBidder to take all necessary steps to prevent the sides of trenches and pits from collapsing. Since the work is to be executed in the existing plant, the safety of the adjacent structures including foundation shall be protected.

3.05.10.1 **Close Timbering**

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 250 x 40 mm sections as directed by the Owner. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting, and shall be kept apart by horizontal walers of strong wood at maximum 1.2 metres spacing, cross strutted with ballies or as directed by the Owner. The length of the bally struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical walers, which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip out.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.05.10.2 **Open Timbering**

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250 mm width and minimum 40 mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Owner. In all other respects, specification for closetimbering shall apply to open timbering.

3.06.00 **Treatment of Slips**

The SuccessfulBidder shall take all precaution to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond the control of the SuccessfulBidder, the same shall be removed by him and payment shall be made to him on appropriate item rate





of earthwork. Slips caused due to negligence of the Successful Bidders shall be cleared and back-filled later by him.

3.07.00 **Back-filling**

3.07.01 **General**

The material used for backfilling shall consist of material, approved by the Owner obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the Owner. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc.

In certain locations, the Owner may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete. No extra cost shall be claimed by the bidder on account of this.

3.07.02 **Filling and Compaction in Pits and Trenches around Structures**

As soon as the work in foundations has been accepted, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc., and filled with earth in layers not exceeding 250 mm in loose thickness each layer being watered, rammed and properly compacted to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part-VII) where backfilling with cohesive soil and sandy silt containing high percentage of silt. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75% as per IS-2720 part XIV. Earth shall be rammed with approved mechanised compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Owner. Compaction of the structure backfill by inundation with water shall not be permitted. The final surface shall be trimmed and levelled to proper profile as shown in the drawing and as desired by the Owner.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimise the moisture content.

3.07.03 **Plinth Filling**

The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as stated under clause no. 3.7.2 with approved compaction machine or manually, if specifically permitted by the Owner. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be given to the floor.

3.07.04 **Filling in Trenches for Water Pipes and Drains**





Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or laterite or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. The types of bedding & pipe surround material shall be as specified in the drawings or as specified elsewhere in the specification.

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed.

Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered, rammed and compacted taking care that no damage is caused to the pipe below. Filling of trenches shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.

In case of excavation of trenches in rock, the filling up to a depth of 300 mm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock, laterite or ash according to the availability at site. The remaining filling shall be done with rock filling of boulders of size not exceeding 150 mm mixed with fine material as available to fill up the voids, watered, rammed and compacted.

3.07.05 Filling in Disposal Area

Surplus material from excavation which is not required for backfilling shall be disposed of in designated disposal areas within a lead of 10KM. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas rollers shall be employed and compaction done to the satisfaction of the Owner at the optimum moisture content which shall be checked and controlled by the Successful Bidder.

In certain cases the Owner may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench.

3.08.00 Approaches and Fencing

The Successful Bidder should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the Project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.





3.09.00 Lighting

Full scale area lighting is to be provided by the bidder if night work is permitted or directed by the Owner. If no night work is in progress, red warning lights should be provided by the bidder at the corners of the excavated pit and the edges of the fill.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Excavation

On completion of excavation, the dimensions of the pits shall be checked as per the drawings after the pits are completely dewatered the work shall be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by placing ordinary concrete of M10 proportion and/or richer and/or by compacted earth, as directed by the Owner/Consultant. The choice of grade of concrete shall be a matter of unfettered discretion of the Owner / Consultants.

Over excavation of the sides shall be made good by the SuccessfulBidder while carrying out the back-filling.

The excavation work shall be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.02.00 Back-filling

The degree of compaction shall be sufficient to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part - VII) or a relative density of 75% as per IS-2720 (Part-XIV) as applicable depending on the nature of back filling material as stated in clause no. 3.7.2 of this specification. The work of back-filling shall be accepted after the Owner is satisfied with the degree of compaction achieved.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 After Award

Details of Equipment proposed to be used for excavation, back-filling and compaction have to be submitted before commencing the work.

5.02.00 After Award of Contract

After award of the Contract the SuccessfulBidder shall submit the following for approval and adoption:





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- a) SuccessfulBidder shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation of the various foundations and the time required for back-filling and compaction after completing the foundation for structures.

The programme should show how the excavation and back-filling quantities shall be balanced, minimising temporary stacking of soils. It is to be noted that the Owner even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with the progress of foundations without attracting any claims from the SuccessfulBidder. The initial programme being submitted by the SuccessfulBidder should have sufficient flexibility to take care of such reasonable variations.

- b) The SuccessfulBidder shall submit drawings showing details of slopes, shorings, approaches, sump pits, dewatering lines, fencing etc. for approval of the Owner/Consultant for adoption.





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for
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2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: A

SUB SECTION: IV

**GUIDELINE
FOR
CEMENT CONCRETE (PLAIN & REINFORCED)**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part A; Sub Section: IV
Cement Concrete (Plain & Reinforced)



**Tender Specification
for
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**VOLUME: II-B
SECTION: I**

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**GUIDELINE
FOR
CEMENT CONCRETE (PLAIN & REINFORCED)**

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or pre-cast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work.

1.02.00 This specification shall also apply to the extent it has been referred to or applicable with the special requirements of structures covered in IS:456.

1.03.00 IS:456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate IS Code, specifications and/or replacement by any International Code of practice as may be specified by the Consultant shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Successful Bidder.

The work to be provided for by the Successful Bidder, unless otherwise specified shall include but not be limited to the following :-

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Design and prepare working drawings of formworks, scaffolds, supports, etc. and submit for approval.





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- c) Submit for approval shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- d) Submit for approval detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.
- e) Submit for approval detailed schemes of all operations required for executing the work, e.g. Material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- f) Design and submit for approval concrete mix designs required to be adopted on the job.
- g) Furnish samples and submit for approval results of tests of various properties of the following:
 - i) The various ingredients of concrete
 - ii) Concrete
 - iii) Embedments
 - iv) Joint seals
- h) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- i) For supply of certain materials normally manufactured by specialist firms, the Successful Bidder shall produce, if directed by the Owner/Consultant, a guarantee in approved proforma for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Successful Bidder, jointly and severally.

2.02.00 Work by Others

No work under this specification shall be provided by any agency other than the Successful Bidder unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 After award

The following technical information shall be furnished after award:





- a) Source and arrangement of processing of aggregates proposed to be adopted.
- b) Type of plant and equipment proposed to be used.
- c) Names of firms, if any, with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.03.02 **After Award of Contract**

The following information and data including samples wherenecessary shall be submitted by the Successful Bidder progressively during the execution of the contract.

- a) Programme of Execution and Requirement of Materials

This Master Programme may have to be reviewed and updated by the Successful Bidder, quarterly or at more frequent intervals as may be directed by the Owner's Consultant depending on the exigencies of the work.

Detailed day to day programme of every month shall be submitted by the Successful Bidder before the end of the previous month.

- b) Samples

Samples of the following materials and any other materials proposed to be used, shall be submitted as directed by the Owner/Consultant, in sufficient quantities for approval. Approved samples shall be preserved by the Consultant for future reference. The approval of the Owner/Consultant shall not, in any way, relieve the Successful Bidder of his responsibility of supplying materials of specified qualities:

- i) Coarse and fine aggregates
- ii) Admixtures
- iii) Plywood for Formwork
- iv) Embedded and anchorage materials as may be desired by the Owner/Consultant.
- v) Joint sealing strips and other waterproofing materials.
- vi) Joint filling compounds
- vii) Foundation quality Rubber Pads





c) Design Mix

Design mix as per Clauses 2.01 (f) & 3.04 of this specification giving proportions of the ingredients, sources of aggregates and cement, along with accompanying test results of trial mixes as per relevant I.S., shall be submitted to the Owner/Consultant for his approval before it can be used on the works. After approval of design mix if the bidder changes the source of the aggregates or brand/type of the cement for any reason, fresh design mix shall be carried out and get approved by the owner.

d) Detail Drawings and Bar Bending Schedules

Detailed working drawings and Bar Bending Schedules in accordance with Clause 2.01(b).

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01 (b).

f) Detailed Drawings for Templates & Temporary Supports for Embedments

As per Clause 2.01 (d).

g) Mill Test Reports for Cement & Reinforcing Steel

h) Inspection Reports

Inspection Reports in respect of Formwork and Reinforcement and any other item of work as may be desired by the Owner/Consultant in accordance with Clause 2.04 of this specification.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0 : SAMPLING & TESTING of this specification.

j) Any other data which may be required as per this specification.

2.04.00 Conformity with Design

The Successful Bidder shall prepare check lists in approved proforma which shall be called 'Pour Cards'. These Pour Cards shall list out all items of work involved. The Successful Bidder shall inform the Owner/Consultant, sufficiently in advance, whenever any particular pour is ready for concreting.





He shall accord all necessary help and assistance to the Owner/Consultant for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the Owner/Consultant shall give written permission on the same 'Pour Card' allowing the Successful Bidder to commence placement of concrete. Details of all instructions issued by the Owner/Consultant and the records of compliance by the Successful Bidder, deviations allowed by the Consultant and any other relevant information shall be written on accompanying sheets attached to the Pour Cards. These sheets, termed as 'Progress Cards', shall be prepared by the Successful Bidder on approved proforma. The Pour Cards along with accompaniments shall be handed over to the Owner before starting placement of concrete.

One of the mix designs developed by the Successful Bidder as per the I.S. Specifications and established to the satisfaction of the Owner by trial mixes shall be permitted to be used by the Owner, the choice being dictated by the requirements of designs and workability.

The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete shall be as approved or directed by the Owner.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Code unless stated otherwise and be of best approved quality.

2.05.02 Cement

Generally cement shall be 43 grade ordinary Portland Cement conforming to IS-8112. In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Owner/Consultant:

- a) 53 Grade ordinary Portland Cement conforming to IS-12269
- b) Rapid hardening Portland Cement conforming to IS-8041
- c) Portland slag cement conforming to IS-455
- d) Hydrophobic Cement conforming to IS-8043
- e) Low heat Portland Cement conforming to IS : 12600
- f) Sulphate Resisting Portland Cement conforming to IS-12330

2.05.03 Aggregates





Aggregates shall be natural or crushed stone or crushed rock and free from deleterious material. It shall comply with the requirements of IS-383. All fine and coarse aggregate shall be tested for susceptibility to Alkali Silicate reaction in a laboratory approved by the Owner/Consultant.

a) Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm shall be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries and conforming to IS:383 shall be allowed to be used on the works. Aggregates shall be washed to make it free from deleterious materials, if necessary.

The grading of coarse aggregates by sieve analysis shall be as per IS:383. If by the analysis the deficiency of a particular grain size is found, which could affect the density of the concrete, the Owner/Consultant may ask the Successful Bidder to avoid such quantities of aggregate of the particular size or and such quantity of aggregate of any particular size to achieve the required grading as per IS:383.

b) Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS:383 (latest revision) is termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification shall be allowed to be used on works. Normally river sand shall be used as fine aggregates.

In case of unavailability of normal specified river sand, the M sand or Crushed stone sand shall be used with the approval of the Owner /Consultant as per given criteria/specifications below.

- i) As per Cl. 3.1.4 , of IS-383 (latest revision) the terminology of M-sand (manufactured sand) as defined as fine aggregate manufactured from other than natural sources, by processing materials using thermal or other processes such as separation, washing, crushing and scrubbing. Generally the M-sand or Crushed stone sand for the fine aggregate is produced by crushing the hard stone.

The Crushed stone sand or M-sand conforming to the following shall only be used as fine aggregate in making concrete for sub and superstructures.

The Crushed stone sand is to be manufactured using VSI crushers only and not with HSI crushers. In order to remove the fines, Crushed stone sand manufacturer should have





mechanized washing facility unit. Crushed sand stone conforming to Grading zone –II as per IS-383 (latest rev.) shall only be used. The M-sand shall comply all the parameters and recommendations of IS: 383 (latest rev.)

- ii) The M-sand shall be used only after the following tests are to be conducted by the bidders at the NABL accredited laboratories with proven track records of performing such type of tests by sending sealed samples of the materials –
- Gradation Test.
 - Petrography.
 - Silt content.
 - Permeability test.
 - Adulteration test.
 - Design Mix Report.
 - Chemical Analysis Report

Using of M-Sand/Crushed Stone Sand based on the Test reports shall only be done after written approval of Engineer–In-Charge.

- iii) The Crushed stone sand in general shall not be used for the following structures/facilities :-
- Structures constructed using slip form technology
 - All internal & external plastering works.

The structures where the slip form construction is envisaged the M-sand or Crushed stone sand may be used for casting its foundations only as they are not constructed using slip formTechnology.

- iv) Special care for design mix, cement content and necessary curing in the initial stage shall be taken care of while using M-sand /Crushed stone sand. However if the results are not satisfactory, the use of crushed stone sand shall not be allowed for all RCC floor slab upto and including 150 mm thickness, which are directly exposed to the atmosphere immediately after casting. In such cases the ordinary river sand shall be used.
- v) The M-sand/Crushed stone sand manufacturing locations shall be inspected by the Owner before giving approval for supply. The bidder shall ensure that the manufacturing process is done using only VSI crushers & shall have mechanized water washing unit for removal of fines in the Crushed stone sand manufactured.



Aggregates smaller than 4.75 mm and within the grading limits and other requirements set in IS-383 (latest rev.) as termed as fine aggregate. Only fine aggregate from approved sources and conforming to IS: 383 (latest rev.) shall be used for execution. The bidder shall have well developed site laboratory and quality control team to take extra care while manufacturing and casting concrete using M-sand/ Crushed stone sand.

Normally, any particular structure shall be constructed by using any one type of sand (fine aggregate) only as per the direction / approval of engineer-in-charge. In general, it is not permitted to use different types of sand in any particular structure.

2.05.04 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. Generally, IS:3550 shall be followed for routine tests. Acceptance test for water shall be as per IS:3025, and Table-1 of IS:456.

In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by compressive strength and initial setting time tests as per method of tests in accordance with the requirements of IS-516 & IS- 4031 respectively. The PH value of water shall generally be not less than 6.

2.05.05 Admixture

Only admixture of approved quality shall be used when directed or permitted by the Owner/Consultant. The different types of admixtures which may be necessary to satisfy the concrete mix and the design requirement shall be as per the following I.S. Standards:

IS : 2645 - Integral cement water proofing compound

IS : 9103 - Indian standard specification for Admixtures for Concrete or equivalent American Codes (ASTM C494 and ASTM C260) or British Codes (BS 5075 , Part 1 to 3) and may be one of the following :

a) Accelerating admixtures :

- Set accelerating admixtures like "Sigunit Powder" or "Sigunit LN10" or equivalent.

b) Retarding admixtures :

- Modified lignosulphonate based set retarding concrete admixture like , "Plastiment R" or equivalent.





- c) Water reducing admixtures :
- Modified sulphonated melamine formaldehyde based water reducing concrete admixture like, "Sikament" or equivalent.
- d) Air entraining admixtures :
- Modified lignosulphonate based air entraining concrete admixture like "FLOMO AEP " or surface - active agents like "Sika AER" or equivalent.
- e) Water proofing admixtures

All water retaining structures shall be provided with water proofing admixtures.

- Modified ligno-sulphonate based waterproofing admixture like "Plastocrete Super" or equivalent.

However, the Successful Bidders shall furnish following technical information about the admixtures (along with the manufacturer's Catalogue) which he is planning to use in different areas within the scope of work for the approval of the Owner/Consultant:

- i) Type of admixture
- ii) Mix proportion & mode of application in concrete/mortar
- iii) Manufacturer's specification & necessary quality assurance certificates (mainly on chloride & sulphate content , PH value infra-red analysis & solid content.)

2.05.06 Reinforcement

Reinforcement shall be of Fe 500 grade Corrosion Resistant Steel and as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work.





Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Owner/Consultant, shall not be used for concrete and shall be removed from site immediately, failing which, the Ownershall be at liberty to get the materials removed and Storage of materials shall conform to IS:4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Successful Bidder to the satisfaction of the Owner/Consultant.

Cement shall be stored off the ground in dry, leak proof, well-ventilated ware-houses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Owner/Consultant, as soon as it is detected.

Different types of cement shall be clearly marked with the Type and different types of cement shall not be intermixed.

2.06.03 Aggregates

Aggregates shall be stored on planks or steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Owner/Consultant.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Owner/Consultant. It shall be protected from rusting, oil, grease and distortions. If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Successful Bidders shall establish and maintain quality control for different items of work and materials as may be directed by the Owner/Consultant to assure compliance with contract requirements and maintain and submit to the Owner/Consultant records of the same.





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The quality control operation shall include but not be limited to the following items of work :

- a) Admixture : Type, quantity, physical and chemical properties that affect strength, workability and durability of concrete.
For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits
- b) Aggregate : Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.
- c) Water : Impurities tests.
- d) Cement : Tests to satisfy relevant IS Specifications
- e) Formwork : Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.
- f) Reinforcement : Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.
Material tests or certificates to satisfy relevant IS Specification
- g) Grades of concrete : Usage and mix design, testing of all properties.
- h) Batching & Mixing : Types and capacity of plant, concretemixers and transportation equipment.
- i) Joints : Locations of joints, water stops and filler materials. Dimension of joints, quality and shape of joint material and splices.
- j) Embedded and Anchorage Items : Material, shape, location, setting.
- k) Placing : Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning





and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.

- l) Compaction : Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
- m) Setting of base & Beaming plates : Lines, elevations and bedding mortar.
- n) Concrete Finishes : Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
- o) Curing : Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Owner/Consultant for approval as may be desired.

3.00.00 INSTALLATION

All installation requirements shall be in accordance with IS:456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Owner/Consultant.

3.01.00 Washing and Screening of Aggregates

Washing and Screening of coarse aggregate shall be carried out to remove fines, dirt or other deleterious materials.

Washing of fine aggregate shall not be allowed, Fine aggregates shall be screened only to remove dirt or other deleterious materials.

However, all washing & screening of aggregates shall be carried out by approved means to ensure compliance with the aggregate specification.

3.02.00 Admixture





All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete.

Admixtures may be permitted to be used in accordance with IS:456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Owner/Consultant reserves the right to require laboratory test or use test data, or other satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Owner/Consultant.

3.03.00 Grades of Concrete

Structural concrete grade shall be as per stipulations mentioned in the Design criteria and for other part of the work if not covered, shall be as shown on the drawing as per grade classification of IS-456 and in case of liquid retaining structures, IS:3370 shall be followed.

3.04.00 Proportioning and Works Control

3.04.01 General

Proportioning of ingredients of concrete shall be made by any of the two following methods as directed by the Owner/Consultant.

- a) With preliminary tests by designing the concrete mix. Such concrete shall be called 'Design Mix Concrete'.
- b) Without preliminary tests adopting nominal concrete mix. Such concrete shall be called 'Nominal Mix Concrete'.

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades permitted in accordance with IS:456 may be used if shown on drawings or approved by the Owner/Consultant. In all cases the proportioning of ingredients and works control shall be in accordance with IS:456 and shall be adopted for use after the Owner/Consultant is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02 Mix Design Criteria

Concrete mixes shall be designed by the Successful Bidder to achieve the strength, durability and workability necessary for the job, by the most economical use of the various ingredients. In general, the design shall keep in view the following considerations:

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.





- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) Chemical admixtures may be used to modify the rate of hardening, to improve workability (maintaining low water - cement ratio) or as an aid to control concrete quality.
- e) The finished concrete should have adequate durability in all conditions, to withstand satisfactorily the weather and other destructive agencies which it is expected to be subjected to in actual service.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Owner/Consultant. The Successful Bidder shall strictly abide by the same in his design of concrete mix installation. Notwithstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water-cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different condition of exposure, strength requirement for different grades of concrete, proportion for nominal mix concrete, values given in the tables in IS:456, shall be followed.

Various trials shall be given by the Successful Bidder with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

TABLE - I

STRENGTH REQUIREMENT OF CONCRETE

	Specified Characteristic Compressive Grade of concrete strength of 15 cm Cubes at 28 days conducted in accordance with IS:516 (All values in N/Sq.mm)
M - 15	15
M - 20	20
M - 25	25
M - 30	30
M - 35	35
M - 40	40





NOTE: 1 - Concrete Grade M-15 shall be used as lean concrete for simple foundations for masonry walls, below the reinforced concrete foundations and mass filling. Grades of concrete lower than M-35 shall not be used in reinforced concrete. These mixes need not be designed.

TABLE - II

**MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE
DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT
VALUES OF WATER - CEMENT RATIO**

(FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILITY	WATER/ CEMENT RATIO	RATIO BY WEIGHT OF CEMENT OF GRAVEL AGGREGATE		RATIO BY WEIGHT OF CEMENT OF CRUSHED STONE AGGREGATE	
		20 mm size	38 mm size	20 mm size	38 mm size
Very low	0.4	01:04.8	01:05.3	01:04.5	01:05.0
Slump	0.5	01:07.2	01:07.7	01:06.5	01:07.4
0-25 mm	0.6	01:09.4	1:10	01:07.8	01:09.6
	0.7	1:10	1:12	01:08.7	01:10.6
Low	0.4	01:03.9	01:04.5	01:03.5	01:04.0
Slump	0.5	01:05.5	01:06.7	01:05.0	01:05.5
25-50 mm	0.6	01:06.8	01:07.4	01:06.3	01:07.0
	0.7	01:08.0	01:08.5	01:07.4	01:08.0
Medium	0.4	01:03.5	01:03.8	01:03.1	01:03.6
Slump	0.5	01:04.8	01:05.7	01:04.2	01:05.0
50-100 mm	0.6	01:06.0	01:07.3	01:05.2	01:06.2
High	0.4	01:03.2	01:03.5	01:02.9	01:03.3
Slump	0.5	01:04.4	01:05.2	01:03.9	01:04.6
100-175 mm	0.6	01:05.4	01:06.7	01:04.7	01:05.7
	0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTE : 1 - Notwithstanding anything mentioned above, the cement/Total aggregate ratio is not to be increased beyond 1:9.0 without specific permission of the Owner/Consultant.





NOTE : 2 - It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water- cement ratios which may be required to be used in mass concrete work only.

NOTE : 3 - The above figures are for guidance only, the actual cement/aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

3.05.00 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland slag cement is used, shall be as per Table-2 of IS:456. All other relevant clauses of IS:456 shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be 400 kg/cum and as per Vol-IIB-Section-I, Part-A, Sub Section-I.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on -

- a) The requirement of strength.
- b) The requirement of durability.

3.07.01 Strength Requirement

In case of 'Design Mix Concrete', the water-cement ratio of such value as to give acceptable test results as per IS:456 shall be selected by trial and error. The values of water-cement ratios for different grade and mix designs shall have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Owner/Consultant. Frequent checks on test shall have to be carried out and the water-cement ratios shall be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Successful Bidder's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, proportions for different grades of concrete is specified in Table-9 of IS:456 and no tests are necessary. The acceptance test criteria for nominal mix concrete shall be as per IS:456.

3.07.02 Durability Requirement

Table-5 of IS:456 gives the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks and contact with harmful chemicals. Impermeability may also be an important consideration.





Whenever the water-cement ratio dictated by durability consideration is lower than that required from strength criterion, the former shall be adopted.

In general the water cement ratio between 0.4 and 0.45 shall be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete.

The Successful Bidder may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer / super-plasticizer. However the Successful Bidder has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer. It shall be preferable to use Melamine based plasticizer.

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below :

TABLE - III

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm with Standard Cone as per IS:1199		Use for which concrete is suitable.
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipment, roads and like.
Low	25	50	Uncongested wide and shallow R.C.C. structures.
Medium	50	100	Deep but wide R.C.C. structures with congestion or reinforcement and inserts.
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.





(NOTE: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Owner/Consultant)

With the permission of the Owner/Consultant, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively where facilities exist or if required by the Owner/Consultant, the compacting factor test in accordance with IS:1199.

3.09.00 Size of Coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Owner/Consultant:-

Very narrow space	- 12 mm
Reinforced concrete including foundation	- 20 mm
Ordinary Plain concrete M10 and below	- 40 mm
Mass concrete	- 40 mm
Mass concrete in very large structure	- 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that shall work readily into position without segregation.

Coarse aggregate shall normally be separated into the following sizes and stacked separately in properly designed stockpiles :

40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions. Coarse aggregates more than 40mm size shall not be used in concrete.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.10.00 Mixing of Concrete

Concrete shall always be mixed in mechanical mixer unless specifically approved by the Owner/Consultant for concrete to be used in unimportant out of the way locations in small quantities. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates





constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum.

When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Owner/Consultant. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Owner/Consultant as per IS:4634 on all mixers employed at site. Only those mixers whose efficiencies are within the tolerances specified in IS:1791 shall be allowed to be employed.

Ingredients for design mix concrete shall be measured by weight. For small jobs portable swing weigh Batcher conforming to IS:2722 may be used.

Batching plant conforming to IS:4925 shall be used for large jobs. The accuracy of the measuring equipment shall be within + 2% of the quantity of Cement, water or total aggregates being measured and within + 5% of the quantity of any admixture being used. The batching equipment shall be fitted with an accurate mechanism for weighing separately the cement, fine aggregate and coarse aggregate. Water may be measured by volume or by weight. All measuring equipment should be maintained in a clean serviceable condition, and their accuracy shall be checked periodically.

Mechanical / electrical control shall be provided on the mixing equipment to ensure the batch cannot be discharged until approved mixing time has elapsed and the entire batch shall be discharged before the mixer is recharged.

Where admixtures are employed, separate containers & measuring devices shall be used.

For minor concreting works, batching by volume according to specific weight may be permitted by the Owner/Consultant. In that case the whole bags of cement shall be used and gauge boxes used for measuring aggregates.

When hand mixing is permitted by the Owner/Consultant, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is



continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch.

3.11.00 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as shall prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design shall be used. If, in spite of all precautions, segregation does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Owner/Consultant, concrete shall be transported in deep containers which will reduce the rate of loss of water by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipments shall be kept free from set concrete.

3.12.00 Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code shall be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in the relevant I.S. Code for any particular aspect of work, any other standard Code of practice, as may be specified by the Owner/Consultant, shall be adopted. Concrete may have to be placed against the following types of surfaces:

- a) Earth foundation
- b) Rock foundation
- c) Formwork
- d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. All excavated areas for foundations, ring beams, plinths, pile caps etc. shall be rammed & consolidated properly before blinding with nominal mix plain concrete, as per drawing and / or direction of the Owner/Consultant and shall be allowed to cure prior to setting out steel fixing, shuttering and concrete pouring for the main structural element.





Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Owner/Consultant before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Owner/Consultant and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Owner/Consultant.

Rock foundation or construction joint shall be kept moist for at least 72 hours prior to placement. Concrete shall be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Owner/Consultant shall have to be adopted.

Formwork shall be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed and cement slurry shall be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar shall be deemed to be included.

After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice. In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Owner/Consultant, doubtful, in addition to immersion vibrators the Successful Bidder may have to employ form vibrators conforming to IS:4656. For slabs and other similar structures, the Successful Bidder shall additionally employ screed vibrator as per IS:2506. Hand tamping may be allowed in rare cases, subject to the approval of the Owner/Consultant. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.





The size of the concrete pours must be carefully considered prior to commencement to ensure the structural elements are poured in on continuous shift to avoid cold joints.

Slabs, beams and similar members shall be poured in one operation, unless otherwise instructed by the Owner/Consultant. Moulding, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Owner/Consultant. Holes shall be provided and bolts, sleeves, anchors, fastenings or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Owner/Consultant. Any deviation therefrom shall be set right by the Successful Bidder as instructed by the Owner/Consultant.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Owner/Consultant may direct to remove the portion and reconstruct or repair the same.

The Owner/Consultant shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at certain predetermined stages. These joints shall be formed in a manner specified in the drawings/ Instruction. Vertical construction joints shall be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint. For water retaining structures and leak-proof buildings suitable approved water bars shall be installed at the construction joints.

Where the location of the joints is not specified, it shall be in accordance with the following:

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.





- b) Concrete in a beam shall preferably be placed without a joint, but if provision of a joint is unavoidable, the joint shall be vertical and within the middle third of the span.
- c) A joint in a suspended floor slab shall be vertical and within the middle third of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Successful Bidder proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Owner/Consultant for study and approval without which no construction joint shall be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Successful Bidder should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.
- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface shall be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness (not leaner than the grade of concrete under consideration), shall be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint shall be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise in spite of extensive vibration, the joint shall be left to harden for at least 12 - 24 hrs. It shall then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under Clause 3.12.





3.14.00 Repairs, Finishes and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection shall not be accepted and at successful bidder's own risk and cost, shall have to be dismantled, removed and replaced by sound concrete. The Owner/Consultant may, at his sole discretion, allow to retain concrete with minor defects provided the Successful Bidder is able to repair it by approved methods. All concrete work shall be inspected by the Successful Bidder immediately after the forms are removed and he shall promptly report occurrence of any defects to the Owner/Consultant. All repair works shall be carried out as per the instructions and in the presence of the Owner/Consultant or his representative. Generally, repair work shall consist of any or all of the following operations:

- a) Sack rubbing with mortar and stoning with carborundum stone.
- b) Cutting away the defective concrete to the required depth and shape.
- c) Cleaning of reinforcement and embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grouting with a cement-sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortar.
- k) Polymer modified patching and adhesive repair mortar for beams & columns.

3.14.02 Finishing Unformed Surface





A few typical and common cases of treatment of concrete surface are cited below:

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforcement concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance.

No over-trowelling, to obtain a very smooth surface, shall be done as it will prevent adequate bond with the subsequent finish. If desired by the Owner/Consultant, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling by hand or by rotary power float is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples and trowel marks. A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Owner/Consultant may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beams, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Successful Bidder shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy and details of such hacking shall meet with the approval of the Owner/Consultant, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing.





Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days or as otherwise instructed by the Owner/Consultant. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding.

Steps, as approved by the Owner/Consultant, shall be taken to protect immature concrete from damage by debris, excessive loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, polythene sheet, hessian, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water shall be allowed if the Owner is satisfied with the adequacy of the arrangements made by the Successful Bidder.

If permitted by the Owner, curing compound like "ANTISOLE (WP)" may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water sheen from concrete surface.

It is important not to apply the curing compound when standing water is still present on concrete.

The Successful Bidder shall arrange for the manufacturer's supervision.

The Successful Bidder shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Owner's decision regarding the adequacy of curing is final.

In case any lapse on the part of the Successful Bidder is noticed by the Owner, he shall inform the Successful Bidder or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Successful Bidder within 3 (three) hours of issuance of such instruction, the Owner shall be at liberty either to employ sufficient means through any agency to make good the deficiency and entirely at the discretion of the Owner and at bidder's cost.

3.16.00 Reinforcement

Mild steel round bars, cold twisted and deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc., shall be used as reinforcement as per drawings and directions. The reinforcing bars





shall be TMT CRS of grade Fe500 as per IS 1786(latest revision). If required, in an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS:9077, as shown on the drawing or as directed by the Owner/Consultant.

3.16.01 Bar Bending Schedules

The Successful bidder shall submit to the Engineer for approval Bar Bending Schedules with working drawings in triplicate, showing clearly the arrangements proposed by the Successful bidder to match available stock of reinforcing steel, within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings, whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the Successful bidder shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. Approval of such detailed drawings by the Engineer shall not relieve the Successful bidder of his responsibility for correctness nor of any of his obligations to meet the other requirements of the Contract.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Cutting & Bending of Reinforcement

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS:2502 or as approved by the Owner/Consultant. Bends and shapes shall comply strictly with the dimensions corresponding to the approved Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Successful Bidder before any bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Owner/Consultant, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that shall injure the material. Rebending can be done only if approved by the Owner/Consultant. Reinforcing bars above 16 mm diameter shall be bent by machine producing a gradual and even motion. Bars of 16 mm or below may be bent by hand. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat(not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

Reinforcing bars, whether high yield or mild steel shall be cut using either hand held shears, guillotines or foot operated pneumatic cutters. Cutting bars using cold chisels may be allowed by the Owner/Consultant at exceptional cases.





3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks irrespective of whether such supports are payable or not. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by three strands of No. 20 G/two strands of 18G/one strand of 16G annealed soft iron wire. Tack welding of bars should not be done unless permitted by the Owner/Consultant. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held.

The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Successful Bidder shall study the drawings thoroughly and inform the Owner/Consultant in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Owner/Consultant.

3.16.05 Welding

Normal bond laps in reinforcement may be placed by lap or butt welding reinforcement bars, if asked by the Owner/Consultant, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS:2751 and IS:456. Welded mesh fabrics conforming to IS:1566 may also be used if specified in the Schedule of Items and Drawings.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Owner/Consultant for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out.

Laps and anchorage lengths of reinforcing bars shall be in accordance with IS:456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable and as directed by the Owner/Consultant. Arrangements for placing concrete shall be such that reinforcement in position do not have to bear extra load and get disturbed.

The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Owner/Consultant. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by volume and cured in a pond for at least 14





(fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Owner/Consultant.

3.17.00 Cold Weather Concreting

When conditions are such that any operation of concreting may be expected to be done at 5°C atmospheric temperature or below the work shall conform to the requirement of Clause 14 of IS:456 and IS:7861. (Part. II).

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Successful Bidder shall take all precautions as per IS:7861 (Part-I) and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 40°C while placing. Positive temperature control by precooling, postcooling or any other method, if required, shall be specified.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 14 of IS:456.

3.20.00 Form Work

3.20.01 General

Formwork shall conform to the shape, grade, lines, levels and dimension as shown on the drawings. The Successful Bidder shall prepare design & working drawings for formwork & temporary support system for important structures and get them approved by the Owner/Consultant prior to commencement of actual work.

Materials used for the formwork inclusive of the supports and centering shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Owner/Consultant.

The centering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Reckers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as the working load, in case the Successful Bidder wishes to adopt any other design criteria, he has to convince the Owner/Consultant about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its





components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Owner/Consultant shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used.

Alternatively, except in case of water retaining structures through rods and the tie bolts shall be sleeved with PVC conduits to allow retraction of the ties on removal of the shutters. Where required, the annulus of the conduits shall be filled with expanding mortar to seal the void. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Owner immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 metres span. Unless specifically described on the drawings or elsewhere to the contrary, beveled forms 25 mm by 25 mm shall be fixed in the form-work at all corners to provide chamfering of the finished concrete edges. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Owner. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes, brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil based shutter





release agent like "Separol/Sika form oil/ Siparol Concentrate" before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork.

The oiling of the formwork shall be inspected just prior to placement of concrete and redone wherever necessary.

3.20.02.01 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork. Removing any props or repropping shall not be done except with the specific approval of the Owner/Consultant. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

The design of formwork shall take into account all vertical and lateral loads that the forms shall carry or be subjected to during the construction process. Besides weight and pressures of reinforced concrete and weight of the forms themselves, the design shall consider loading due to unsymmetrical placement of concrete; impact from dumping of concrete; movement of men and construction equipment; wind action and any other imposed load during construction. The Successful Bidder shall assess the magnitude of vertical live load to be taken for design of formwork duly considering his method, sequence and rate of pour of concrete. However, minimum design vertical live load to be considered shall be 750 kg/sqm excluding weight of concrete.

3.20.03 Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Owner/Consultant. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Owner/Consultant shall be obtained.

3.20.04 Removal of Forms

Before removing any formwork, the Successful Bidder must notify the Consultant well in advance to enable him to inspect the concrete if he so desires. The Successful Bidder shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed therefrom and have this record checked and countersigned by the Owner/Consultant regularly.





The Successful Bidder shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him. The Owner/Consultant may, however, instruct to postpone the removal of formwork if he considers it necessary.

Forms for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Owner/Consultant in each case.

TABLE - IV

SCHEDULE OF REMOVAL OF FORM

Part of Structure	Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Temperature °C				Temperature °C			
	40°C	Above 20°C 5°C	40°C.- 20°C 5°C.	Below 5°C.	40°C	20°C	Above 40°C. 5°C	20°C.- Below 5°C
	Days	Days	Days	Days	Days	Days	Days	Days
a) Columns & Walls	2	1	1	Do not remove forms until site cured testspecimen develop at least 50% of the specified 28 days strength	1	1	1	Do not remove forms until site cured test specim-
b) Beam sides	3	2	3		2	1	1	
c) Slabs, 125 mm	10	7	8		7	4	5	
d) Slabs over 125 mm thick and soffit of minor beams	18	14	16		12	8	9	en develop at least 50% of the specified 28 days strength
e) Soffit of main beams	24	21	22		14	10	12	



Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40°C can be reduced to those of the temperature range of 20°C to 40°C subject to approval of the Owner/Consultant.

Construction joints in beams, if required to be provided, shall be located within the middle third of span according to clause 3.13.1(b) of this specification. In such cases, however, entire span of beam shall have to be kept supported by formwork till its removal for the portion of beam, cast at a later date, is due and so approved by the Owner/Consultant.

If any type of cement other than ordinary portland cement and Rapid hardening portland cement is used the time of removal of forms shall be revised as approved by the Owner/Consultant such that the strength of this cement at the time of removal of forms match with strength of portland cement at the time of removal of form as mentioned above. This has to be supported by regular tests.

3.20.05 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this Specification or drawings or directed by the Owner/Consultant :

For

- a) Sectional dimension - ± 5 mm
- b) Plumb - 1 in 1000 of height
- c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Owner/Consultant. Any error, within the above tolerance limits or any other as may be specially set up by the Owner/Consultant, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.06 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Owner/Consultant.





3.20.07 Classification

Generally, the 'ordinary' class formwork shall be used unless otherwise directed by the Owner/Consultant :

- a) Ordinary : These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) Plywood : These shall be used in exposed surfaces, where a specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Owner/Consultant. He may also permit utilisation of used plywood for the 'ordinary' class, if it is still in good condition.
- c) Ornamental: These shall be used where ornamental and curved surface are required and shall be made of selected best quality well-seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Successful Bidder shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Owner/Consultant.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other misc. Embedded Fixtures. The Successful Bidder shall build into concrete work all the items noted below and shall embed them partly or fully as directed and secure the same as may be required. The materials, if required to be supplied by the Successful Bidder, shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Owner/Consultant. Exposed surfaces of embedded materials are to be painted with one coat of approved anti-corrosive paint and/or bituminous paint. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Owner/Consultant. Items to be embedded.





- a) Inserts, hangers, anchors, frames around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Lugs or plugs for door and window frames occurring in concrete work.
- e) Flashing and jointing in concrete work.
- f) Any miscellaneous embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Successful Bidder.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter.

In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids by using water proofing admixtures and water stoppers as specified on the drawings/specifications or as directed by the Owner/Consultant. All materials are to be procured from reliable manufacturers and must have the approval of the Owner/Consultant. Where it is the responsibility of the Successful Bidder to supply the material, the Owner/Consultant may demand test certificates for the materials and/or instruct the Successful Bidder to get them tested in an approved laboratory. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Owner/Consultant before starting the work.

3.23.02 Bitumen Board/Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibre board of approved manufacturer as per IS:1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and





not prepared by cutting to size smaller pieces from larger boards at site. On already concreted surface a coat of hot bitumen shall be applied and the board shall be pasted over it. After placing the board a coat of Bitumen paint may have to be applied on the board against which concrete shall be placed.

At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material shall have to be procured from reliable manufacturers as approved by the Owner/Consultant. The method of installations shall be similar to that recommended by the manufacturers for fixing on cold storage walls. On already concreted surface a coat of hot bitumen shall be applied and the board shall be pasted over it. After placing the board a coat of Bitumen paint may have to be applied on the board against which concrete shall be placed. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

3.23.03 Joint Sealing Strips

Joint sealing strips may be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure.

The sealing strips shall be non-metallic like rubber or P.V.C.

Sealing strips shall not have any longitudinal joint and shall be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs.

The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Owner/Consultant. The Successful Bidder is to supply all labour and material for installation including the material and tools required for jointing, testing, protection, etc. If desired by the Owner/Consultant, joints in rubber seals may have to be vulcanised.





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

Non-metallic sealing strips shall be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features :

- i) Plain
- ii) Central bulb
- iii) Dumb-bell or flattened ends
- iv) Ribbed and Corrugated Wings
- v) V shaped

As these types of seals can be easily handled in very large lengths, transverse joints shall be allowed only under unavoidable circumstances and with the specific approval of the Owner/Consultant.

The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Owner/Consultant taking particular care to match the central bulbs and the edges accurately.

a) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm unless otherwise specified. The actual size and shape shall be as shown in drawings of items and/or as directed by the Owner/Consultant. The material shall be natural rubber and be resistant to corrosion, abrasion and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties shall be generally as follows. The actual requirements may be slightly different as decided by the Owner/Consultant:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C. Sealing Strips

The minimum thickness of P.V.C. sealing strips shall be 3 mm and the minimum width 100 mm unless otherwise specified. The actual





size and shape shall be as shown in drawings/schedule of items and/or as directed by the Owner/Consultant. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties shall generally be as follows. The actual requirements, which shall be directed by the Owner/Consultant, may vary slightly :

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to 80A
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70°C
Ultimate Elongation	:	Not less than 275%

3.23.04 Joint Sealing Compound

When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS:1834.

Alternatively, when directed, the expansion Joints may be filled with joint sealing compound like "Sikalastic" or approved equivalent and shall be applied as per manufacturer's specification.

3.23.05 Isolation Joints

Strong and tough alkathene or PVC sheet about 1 mm in thickness and as approved by the Owner/Consultant shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete, to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Rubber Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings or as directed by the Owner/Consultant. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases





If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Successful Bidder. In general unless otherwise specified, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Owner/Consultant, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If desired by the Owner/Consultant, admixtures like Aluminium powder, 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Owner/Consultant. Admixture, if directed to be added.

Alternatively non-shrink, free flow, cementitious grout like "Sikagrout 214/ Ankor NSG" or approved equivalent specifically selected for the type of equipment to be located (vibrating, static etc.) may also be used for grouting as per manufacturer's specification with necessary approval of the Owner/Consultant.

3.25.00 Precast Concrete

The Specification for precast concrete shall be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose.

This yard shall be dry, properly levelled and having a hard and even as well as well drained surface to prevent excessive uneven settlement due to softening of soil during casting & curing. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Owner/Consultant, casting shall have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 10 (Ten) days of curing and can be removed for erection after 28 (twenty eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal and must be rigid enough to prevent distortion during placing and compaction of the concrete.

Other than normal curing by applying water through spray nozzles or perforated hose curing by high pressure steam, steam vapour or other accepted processes may also be employed to accelerate the hardening of the concrete and to reduce the curing time.

Lifting hooks, where necessary or as directed by the Owner/Consultant, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.





All members shall be indelibly marked with a unique identification mark on a surface which shall not be permanently exposed to show on which production line they were manufactured, their type, the class of concrete, the data of casting and if they are of a symmetrical section the face which shall be uppermost when the member is in its correct position after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Owner/Consultant. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per instructions of the Owner/Consultant. The Successful Bidder shall render all help with instruments, materials and men to the Owner/Consultant for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as directed by the Owner/Consultant. If centerings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement : sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Waterproofing of concrete structures shall be done by either suitable extraneous treatments like applying waterproofing paints like "Sikatop Seal" fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures conforming to IS:2645 and equivalent American or British codes in the concrete or mortar at the time of mixing and/or installing water bars at the joints.

The design, material and workmanship shall conform to the relevant I.S. Codes where applicable. The Consultant's/Owner's approval of the materials shall be obtained by the Successful Bidder before procurement. If desired by the Owner/Consultant, test certificates for the materials and samples shall be submitted by the Successful Bidder. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02 Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be rubber or P.V.C. The materials and installation shall be as described under Clause 3.23.3. Construction joint should be provided as per clause 3.13.1 with or without water bar / Seal as shown on the drawing. In case of water bars being used at the construction Joint, fixing of the same has to be done carefully so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods :





Method 1 : A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting in case of walls. The above bonding agent shall be mixed with water which shall be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two component epoxy resin bonding agent shall be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days :

Compressive strength	-	55 to 60 N /Sq. mm
Flexural Strength	-	25 to 30 N /Sq. mm.
Tensile strength	-	15 N Sq. mm (approx)
Bonding strength to concrete	-	3 N / Sq. mm (approx)
Bonding strength to steel	-	20 N / Sq. mm (approx)

The whole operation shall be done as per manufacturer's specification.

Method 2 : One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 Kg/Sq cm . The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision.

3.26.03 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar / plaster shall conform to relevant IS code. The admixture shall not cause decrease of strength of concrete / plaster at any stage and it is free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5 %





The maximum permissible dosage of admixture shall be 2% (two percent) by weight of cement. The product shall be stored in strong moisture proof packings.

However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water resistant concrete admixture shall be used to provide a waterproof concrete around 410 Kg/ Cu.m a melamine based super plasticizers shall be preferable.

- a) In concrete : The approved admixture shall be based on modified lignosulphonate like "Plastocrete - N/Super" or approved equivalent. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Owner/Consultant. The Successful Bidder shall have the services of the manufacturer's supervisor to supervise the work, if desired by the Owner/Consultant.
- b) In Plaster : The concrete surface, to be plastered, shall be hacked to Owner's/Consultant's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture like "Noleak CP/Sika Latex" or approved equivalent and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Consultant. If desired by the Owner/Consultant, the Successful Bidder shall have the work supervised by the manufacturer's supervisor. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04 Bituminous or Tar Coating on External Surface

The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacturer and quality as per IS:216 (not heated above 375°F) using not less than 2 Kg. per Sq.M. or with hot asphalt i.e., bitumen according to IS:73 (not heated above 400°F) using not less than 1.5 kg. per Sq.M. When the first coat has completely dried up and approved by the Owner/Consultant, the second coat shall be applied in the same manner using not less than 1.25 Kg. per Sq.M. in case of coal tar and 1 Kg. per Sq.M. in case of asphalt. Immediately after application of the second coat





and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely.

In place of hot application by coal tar / asphalt the coating of the outside surfaces of walls may be carried out using a ready to use liquid, bituminous emulsion/rubber protective coating of approved manufacturer for waterproofing purpose.

3.26.05 Protective Coating on Inside Surface

Unless otherwise specified, Two coats of cement based two-components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/ floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt : Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS:1322, and the workmanship to IS:1609. The bitumen felt shall be hessian base and/or fibre base as specified in Drawing. If required by the Owner/Consultant, tests as specified in relevant IS Codes shall be arranged by the Successful Bidder.

The Successful Bidder shall execute this work in direct collaboration with one of the well-known specialists approved by the Owner/Consultant.

Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases, etc. included in scope.

3.26.07 Polyethylene Films : Application in Walls or base of Structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder :

- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6
- ii) apply hot bitumen 80/100 grade (IS:73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethylene film 250 micron (IS:2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.





Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat sealed.

On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen.
- v) Lay hot bitumen 80/100 grade (IS:73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250 micron polyethylene film as second layer similar to (iii) above.
- vii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- viii) Apply hot bitumen (straight run grade) to IS:73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- ix) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6. In case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures shall be protected from adverse effect of soil/ underground water, if shown on drawing or instructed by the Owner/Consultant, by using bitumen emulsion protective coating of approved manufacturer applied with two coats of Hot bituminous painting of grade 20/30 over a coat of Bitumen Primer except where special water proofing is specified for specific structures mentioned elsewhere.

3.28.00 Waterproofing by Pressure /Chemical Grouting

Where required, waterproofing for underground concrete structure shall be done by injecting high polymer based non-shrink waterproof grouting compound through nozzle under pressure as per manufacturer's





recommendation. The pressure during injection shall not be less than 2.5 kg/Sq.cum and the thickness of epoxy resinous emulsion waterproof paint (to be applied on the external surface of walls/slabs) shall not be less than 700 microns.

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Successful Bidder shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Successful Bidder shall get the specimens tested in a laboratory approved by the Owner/Consultant and submit to the Owner/Consultant the test results in triplicate within 3 (three) days after completion of the test.

4.02.00 Cement

Representative samples shall be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths. Soundness Tests may also be required to be carried out if required by the Owner/Consultant.

4.03.00 Aggregates

The Successful Bidder shall carry out any or all the tests aggregates as may be required by the Owner/Consultant in accordance with IS:2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS:3550 shall be carried out by the Successful Bidder at regular intervals and whenever directed by the Owner/Consultant. The final acceptance criteria in case of doubt shall be as per IS:3025 & IS:456.

4.05.00 Admixture

4.05.01 Air Entraining Agents (A.E.A)

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete shall be established by the Successful Bidder by carrying out sufficiently large number of tests. After then, at regular intervals and whenever directed by the Owner/Consultant, the Successful Bidder shall check-up the actual percentages of air entrained





and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures which may be required to be added shall be carried out by the Successful Bidder.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS:516 and IS:1199 the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Owner/Consultant may require other tests to be performed in accordance with IS:516.

Sampling procedure, frequency of sampling and test specimen shall conform to Clause 14 of IS:456.

To control the consistency of concrete from every mixing plant, slump tests and/or compacting factor tests in accordance with IS:1199 and as mentioned in Clause 3.6 of this Specification shall be carried out by the Successful Bidder every two hours or as directed by the Owner/Consultant. Slumps corresponding to the test specimens shall be recorded for reference.

The acceptance criteria of concrete shall be in accordance with Clause 15 of IS:456.

Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Successful Bidder. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures, etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good to the satisfaction of the Owner/Consultant.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to clause 16 of IS:456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to Clause 16 of IS:456.





5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 17 of IS:456.

5.04.00 Load Test

Load tests of structural members may be required by the Owner/Consultant, when the strength of test specimen results fall below the required strength, as per 'Load Test on Parts of Structures', Clause 17.6 of IS:456.

If load testing is decided by the Owner/Consultant, the member under consideration shall be subjected to a test load equal to 1.25 (one and a quarter) times the specified live load used for design and this load shall be maintained for a period of 24 (twenty four) hours before removal. The detailed procedure of the test is to be decided by the Owner/Consultant. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Successful Bidder. Alternatively, if permitted under Statutory Regulations and at the discretion of the Owner/Consultant, the structure under test or a portion thereof may be retained as such without any modification by derating its load bearing capacity, provided the design criteria allows such derating.

A reinforced concrete beam, floor or roof shall be deemed to have passed the test if the maximum deflection at the end of 24 hours does not exceed the deflection given in Clause 17.6 of IS:456.

The entire cost of load testing shall be borne by the Successful Bidder. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same shall be made good by the Successful Bidder to the satisfaction of the Owner/Consultant.

6.00.00 LIST OF I.S. CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian Standard Specifications, any other standard practice, as may be specified by the Consultant, shall be followed :-

IS : 73 - Indian Standard Specification for Paving Bitumen





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- IS : 216 - Indian Standard Specification for Coal Tar Pitch
- IS : 269 - Indian Standard Specification for 33 grade Ordinary Portland Cement
- IS : 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
- IS : 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement - Part 1 & 2
- IS : 455 - Indian Standard Specification for Portland Slag Cement
- IS : 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
- IS : 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures
- IS : 516 - Indian Standard Specification for Methods of Test for Strength of Concrete
- IS : 737 - Indian standard specification for wrought Aluminium and Aluminium Alloy sheet and strip for general Engineering purpose. IS:1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
- IS : 1200 - Indian Standard Specification for Method of (Part-II) Measurement Cement Concrete Works.
- IS : 1200 - Indian Standard Specification for Method of (Part-V) Measurement of Formwork
- IS : 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing
- IS : 1489 - Indian Standard Specification for Portland - Pozzolona Cement - Part 1 & 2
- IS : 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS : 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- IS : 1786 - Indian Standard Specification for high strength deformed Bars & wires for Concrete Reinforcement
- IS : 1791 - Indian Standard Specification for Batch Type Concrete Mixers
- IS : 1834 - Indian standard specification for hot applied sealing compound for joint in concrete.
- IS : 2062 - Steel for general structural purpose.
- IS : 2185 - Indian Standard Specification for Hollow and solid / solid light wt. Cement Concrete Blocks - Part - 1 & 2
- IS : 2210 - Indian Standard Specification for Design of Reinforced Concrete Shell Structures and Folded Plates
- IS : 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS : 2430 - Indian standard specification for method of sampling of Aggregate for concrete.
- IS : 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS : 2505 - Indian Standard Specification for Concrete Vibrators Immersion Type
- IS : 2506 - Indian Standard Specification for Screed Board Concrete Vibrators
- IS : 2514 - Indian Standard Specification for Concrete Vibrating Tables
- IS : 2645 - Integral Cement water proofing compound
- IS : 2722 - Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)
- IS : 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
- IS : 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete. Part - 1 : Pull out Test





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- IS : 3025 - Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water & waste water - art - 1 to 37
- IS : 3201 - Indian Standard Specification for Design and Construction of Precast Concrete Trusses and purlins.
- IS : 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids Part 1 to 4
- IS : 3384 - Indian standard specification for / Bitumen primer for use in waterproofing and Damp proofing
- IS : 3414 - Code of practice for Design and Installation of joints in Buildings
- IS : 3550 - Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
- IS : 3558 - Code of Practice for use of Immersion Vibrators for Consolidating Concrete
- IS : 3696 - Safety Code for Part-1 : Scaffolding and Part 2: Ladders
- IS : 3812 - Indian Standard Specification for Fly Ash for Use as Pozzolona& Admixture
- IS : 4031 - Indian Standard Specification for Method of Tests for Hydraulic Cement - Part - 1 to 14
- IS : 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site
- IS : 4090 - Indian Standard Specification for Design of Reinforced Concrete Archs
- IS : 4634 - Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixers
- IS : 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS : 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant
- IS : 4926 - Indian Standard Specification for Ready Mixed Concrete





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- IS : 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work
- IS : 4991 - Indian Standard Specification for Blast Resistant Design of Structure for Explosion above ground
- IS : 4995 - Indian Standard Specification for Design (Part-I of Reinforced Concrete Bins for the Storage & II) of Granular and Powdery Materials
- IS : 4998 - Indian Standard Specification for Design of (Part - I) Reinforced Concrete Chimneys
- IS : 5512 - Indian Standard Specification for Flow Table for use in Tests of Hydraulic Cement and Pozzolan Materials
- IS : 5513 - Indian Standard Specification for Vicat Apparatus
- IS : 5515 - Indian Standard Specification for Compaction Factor Apparatus
- IS : 5751 - Indian Standard Specification for Precast Concrete Coping Blocks
- IS : 5816 - Indian Standard Specification for Method of Test for Splitting Tensile Strength of Concrete Cylinders
- IS : 5891 - Indian Standard Specification for Hand Operated Concrete Mixers
- IS : 6452 - Indian Standard Specification for High Alumina Cement for Structural Use
- IS : 6909 - Indian Standard Specification for Supersulphated Cement
- IS : 6923 - Indian Standard Specification for Method of Test for performance of Screed Board Concrete Vibrators
- IS : 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures
- IS : 7242 - Indian Standard Specification for Concrete Spreaders
- IS : 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete
- IS : 7251 - Indian Standard Specification for Concrete Finishers





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- IS : 7320 - Indian Standard Specification for Concrete Slump Test Apparatus
- IS : 7861 - Indian Standard Specification for (Part-I Recommended Practice for hot and cold & II) Weather Concreting
- IS : 7969 - Safety Code for Storage and Handling of Building Materials
- IS : 8041 - Indian Standard Specification for Rapid Hardening Portland cement
- IS : 8043 - Indian standard specification for hydrophobic cement
- IS : 8112 - Indian Standard Specification for 43 grade Ordinary Portland Cement
- IS : 8142 - Indian Standard Specification for Determining Setting time of Concrete by Penetration Resistance
- IS : 8989 - Safety Code for Erection of Concrete Framed Structures
- IS : 9013 - Indian Standard Specification for Method of Making, Curing and Determining Compressive Strength of Accelerated - cured Concrete Test Specimens
- IS : 9077 - Code of Practice for Corrosion Protection of Steel Rails in RB and RCC Construction
- IS : 9103 - Indian Standard Specification for Admixtures for Concrete.
- IS : 9417 - Recommendation for welding cold worked bars for reinforced concrete construction
- IS : 10262 - Recommended Guideline for concrete Mix Design
- IS : 12269 - Indian standard specification for 53 grade ordinary portland cement
- IS : 12330 - Indian standard specification for sulphate resting portland cement
- IS : 12600 - Indian standard specification for low heat portland cement





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION: I
PART: A
SUB SECTION: V
GUIDELINE
FOR
BORED CAST IN SITU CONCRETE PILE**



Development Consultants Pvt. Ltd.

**Volume: II-B
Section: I; Part A; Sub Section: V
Bored Cast in Situ Concrete Pile**



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

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**VOLUME: II-B
SECTION: I**

PART: A

SUB SECTION: V

**GUIDELINE
FOR
BORED CAST IN SITU CONCRETE PILE**

1.00.00 SCOPE

This specification deals with the requirements regarding materials, workmanship and installation of bored cast- in-situ reinforced concrete piles and all related items of work like sand filling in the holes after casting the piles, testing the load bearing capacity of individual piles and group of piles, etc. The relevant clauses of the "Technical Specification for Concrete Work", appearing elsewhere in this document, fall within the scope of this specification.

IS:2911 (Part-I/Sec-2), Latest Revision shall form a part of this specification and shall be complied with unless they are at variance with the specification where the latter shall prevail.

Bored Cast-in-situ RCC pile passing through top soil overburden and highly weathered rock layer and terminating in the underlying sand stone layer with a socket length not less than 3D, (where D is the diameter of the pile) within such layer, will be considered. The capacity of the pile will be confirmed by the successful bidder by necessary load testing as per BIS and by design calculations.

To get generalized & tentative idea of sub-surface stratification as a whole, the soil report available with purchaser may be studied. However a confirmatory soil investigation will be done by the contractor after award of work to ascertain the top level of rock layer for their internal assessment of Pile length only. This will in no way affect the pile parameters stipulated in this specification.

2.00.00 GENERAL

2.01.00 Work to be provided by the successful bidder

The work to be provided for by the successful bidder, unless otherwise specified, shall include but not be limited to the following :

- a) Furnish all labour, supervision, services, materials, equipment and accessories, tools, plants transportation including consumables and temporary works required for the supply and installation of piles of





desired capacity.

- b) Mark the proposed sequence of installation on six (6) copies of identification plan. The identification plan will be prepared by the successful bidder as per the basic plan furnished by the Engineer, if so desired by him.
- c) Furnish full details of the proposed piling equipment, accessories, temporary works and method of pile construction for approval of the engineer.
- d) Submit detailed daily report of boring and pile casting incorporating information as required by the Engineer.
- e) Carryout load tests to the satisfaction of the engineer including casting and dismantling of test caps if necessary and submit the test results in approved proforma.
- f) Make necessary earthwork and approaches for movement of pile installation equipment.
- g) Provide all necessary work mentioned under "Technical Specification for Cement Concrete (Plain and Reinforced)", as may be applicable.

2.02.00 Work to be provided by others

No work under this specification will be provided by any agency other than the successful bidder unless specified elsewhere in the Contract.

2.03.00 Codes and Standards

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements/amendments of the following or any other Indian Standard Specifications and Code of Practice.

- IS : 8112 - Indian Standard Specifications for 43 Grade Ordinary Portland Cement.
- IS : 12269 - Indian Standard Specifications for 53 Grade Ordinary Portland Cement.
- IS : 383 - Indian Standard Specifications for Natural Sources for Concrete.
- IS : 432 - Indian Standard Specification for (Part - I)Mild Steel & Medium Tensile Steel Bars and Hard drawn Steel Wire for Concrete Reinforcement : Part I Mild Steel and Medium Tensile Steel Bars.
- IS : 455 - Indian Standard Specifications for Portland Slag Cement.





- IS : 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete.
- IS : 516 - Indian Standard Specifications for Methods of Test for Strength of Concrete.
- IS : 1199 - Indian Standard Specifications for Methods of Sampling and Analysis of Concrete.
- IS : 1786 - Indian Standard Specifications for high strength deformed steel bars and wires for concrete reinforcement.
- IS : 2062 - Steel for General Structural Purposes
- IS : 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete Part - I to VIII.
- IS : 2502 - Code of Practice for Bending & Fixing of Bars for Concrete Reinforcement.
- IS : 2722 - Indian Standard Specifications for Portable Swing Weight Batches for Concrete (Single and Double Bucket Type).
- IS : 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction.
- IS : 2911 - Code of Practice for Design and Construction of Pile Foundations - Bored Cast-in-situ piles. (Part-I/Sec.2)
- IS : 2911 - Code of Practice for Design and (Part - IV)Construction of Pile Foundations - Load Test on Piles.
- IS : 4926 - Indian Standard Specifications for Ready Mixed Concrete.
- IS : 9716 - Guide for Lateral Dynamic Load Test on Piles.

2.04.00 Conformity with design

The successful bidder will prepare check lists in approved proforma which will be called "Pile Installation Cards". At each important stage of the work as decided by the engineer, the work will be checked and approved by the engineer for correctness and conformity with the design, specification and drawings, before allowing the next phase of work to commence. The intermediate checks and approvals by the engineer will not, however, absolve the successful bidder from his total responsibility to execute the work as per the specification and drawings and to remove and/or rectify all work which is





defective or inaccurate.

2.05.00 Materials

2.05.01 General

All materials whether incorporated in the works or used temporarily as aids or for executing enabling works will be of best approved quality conforming to the latest Indian Standard specification.

2.05.02 Casing

Casing in boreholes where used, should be manufactured out of best quality mild steel with proper treatment, the composition and thickness of the materials being of special importance where they are likely to be in contact with harmful chemicals and organic materials causing deterioration in service. Casing to be left in place like in offshore piling should also receive similar consideration in selection. They shall have sufficient strength and rigidity to permit their being driven and not to be distorted by soil pressure or driving of adjacent tubes. They shall be sufficiently water-tight to exclude water during placing of concrete.

2.05.03 Concrete

Concrete type M35 grade shall be used for piles. Materials and method of manufacture for cement concrete shall in general be in accordance with IS: 456. The concrete cube strength on 15 cm. cubes at 28 days shall satisfy the acceptance criteria as per IS: 456. Concrete cubes will be cast as per instruction of the Engineer. These will be cast and cured by the Successful bidder at site for testing. The concrete shall be of such consistency as to give a slump of 100 to 150 mm. The water-cement ratio shall not exceed 0.5. To achieve the specified slump using specified water cement ratio without compromising with strength, suitable plasticiser, if required, may be used at no extra cost, subject to approval of NTPL. If concentration of Sulphate (measured as SO_3) exceeds 0.5% in soil or 1200 ppm in ground water, sulphate resisting cement shall be used. The minimum cement content should be 400 for M35 grade concrete respectively based on subsoil condition requirement besides that required from strength and other considerations.

The physical properties, mechanical properties & gradation of coarse & fine aggregate shall follow IS:383. Testing of aggregate properties (if desired by purchaser) shall follow relevant parts of IS:2386.

Refer General Specification for civil work for construction water.

Preliminary mix design shall be done in accordance with IS:10262 & SP:23 subject to approval of NTPL. Cube tests, slump test & other relevant tests for preliminary mix design and Routine cube test, slump test for regular concreting shall be carried out at site / site laboratory at contractor's own





cost. Concrete cube tests shall be done as per IS : 516. The calibration certificate (not older than one year) of the testing machine.

The calibration certificate (not older than one year) of the testing machine shall be available at site. If purchaser feels any doubt about the calibration, the contractor shall get it checked at an approved laboratory at his own cost. All such tests shall be conducted in presence of purchaser. At least one set (3 cubes for 7 days & 3 for 28 days strength) of cube shall be tested for every 10 piles or at any deterioration in concrete quality if felt purchaser, whichever occurs earlier. Slump tests (apparatus conforming to IS:IS:7320) shall be carried out at least once for each pile or more frequently, if desired by purchaser.

2.05.04 Reinforcement

Reinforcement shall be mild steel bars conforming to IS: 432. If instead of mild steel, Tor steel bars are used, they shall conform to IS : 1786. All bars shall be Corrosion Resistant Steel(CRS). Test certificate for reinforcement steel shall be obtained from recognised agency, before using. The purchaser may desire to check the testing of the same and the contractor shall arrange it in an approved laboratory at his own cost.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be stored so as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the engineer shall not be used, failing which, the engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realized from the successful bidder's dues. The relevant clauses pertaining to storage of material under "Technical Specification for Cement Concrete (Plain and Reinforced)" will apply.

2.06.02 Casing

Mild steel casing will be painted outside with two coats of anticorrosive paint or smeared with protective layer of grease and kept stored in weather proof sheds, off the ground, on sturdy racks in such a manner as to enable quick and easy in spectrum. Epoxy painting on outside surface shall be provided if so specified in the drawing.

2.07.00 Quality Control

The successful bidder shall establish and maintain quality control for different items of work and materials as may be directed by the engineer to assure





compliance with contract requirements and maintain and submit to the engineer records of the same. The quality control requirements stipulated under the "Technical Specification for Cement Concrete (Plain and Reinforced)" will apply wherever relevant. In addition, the requirement will include but not be limited to the following.

- a) Location and plumb : Control survey for accuracy in plan and check for verticality.
- b) Driving of casing : Correction of weight of hammer, length of fall, number of strokes per minute and rate of penetration.
- c) Boring : Boring method to suit soil profile.
- d) Casting of piles : Check inside casing, reinforcement cage, concrete mix, placing, consolidation and curing.
- e) Inspection of pile
- f) Load tests

2.07.01 Any work which fails to conform to the specification will be subject to the issue of a 'non-conformance report' in line with the quality control procedures to be implemented at site. Corrective or remedial action, design modification or product rejection will be reviewed in accordance with site quality plan.

3.00.00 INSTALLATION

All installation requirements shall be in accordance with IS : 2911 (Part - I/ Sec.2) and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification might not have covered all the aspects to the full satisfaction of the engineer.

3.01.00 General

The successful bidder shall furnish complete information about the type of piles offered with sketches of pile sections showing reinforcement, method of boring, details and availability of equipment and accessories formula or data curve on which the bidder bases the load carrying capacity of piles as well as the criteria for determining suitable and sufficient founding of individual piles and any other relevant details.

The bidder will be supplied with bore hole logs or any other data indicating the nature of the soil expected to be encountered. The information furnished to the successful bidder shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. Piles should be founded on suitable





continuous hard strata based on approved soil data. In case the successful bidder is required to drive piles to greater or shallower depths than that is envisaged, no other extra claims will be entertained. The tenderer should, in his own interest, investigate the site thoroughly and take additional bores if he feels it necessary to assess the type of boring equipment to be used and the depth to suitable founding strata.

3.02.00 Design of Pile

IS:2911 (Part 1/Section 2) : 'Code of practice for design & construction of Bored Cast-in-Situ concrete piles', IS : 2911 (part 4) 'Load Test on Piles & IS : 14593 : 'Design And Construction of Bored Cast-in-situ Piles founded on Rocks – Guidelines' will be referred to in conjunction with this specification during the entire design, construction & Load Testing work. These code form the integral part of this specification.

The piles will be bored cast-in-situ cylindrical type RCC piles of 450 mm &/or 550 mm &/or 750 mm &/or 1000 mm dia terminated within underlying sand stone layer with a rock- socket length not less than $3D$ (where D is the diameter of the pile) , to achieve the design capacity. Minimum center to center spacing between adjacent piles will be $2.5 D$.

Sub-surface profile & Level of weathered Rock layer in different locations of the site are furnished in the Soil Investigation report available with purchaser .

The contractor will submit the structural design of pile for approval of purchaser/consultant . The contractor will guarantee the minimum safe vertical compressive design load capacities for piles

Capacity of Single Pile

A) Vertical Compressive capacity

The contractor will submit capacity of piles diameter wise along with design requirement .

B) Uplift Capacity

The Uplift capacity (for tension pile only) of single pile (with $3D$ rock socket), at this site, will be considered as 25 % of their respective Compressive capacity plus buoyant weight of pile. However, the same has to be confirmed by the successful contractor, by field load test on Trial pile before taking up the working piles.

C) Lateral Capacity

The Lateral capacity of single pile, at this site, will be considered as the minimum of the following:-





- i) 5 % of their respective compressive capacity of pile.
- ii) Lateral pile capacity assessed by the successful contractor by initial Pile Load Test on Trial Pile at selected representative locations, before taking up working piles. At least 3 Nos. of such tests is necessary, locations for which will be mutually decided by the contractor & purchaser.

The successful bidder shall satisfy the engineer as to the boring procedure and equipment which he proposes to use for the particular conditions of the site. If the engineer desires, sufficient test piles shall be installed to prove the adequacy of the pile, at the places indicated by the engineer and a load test shall be performed on each pile.

Piles have to be reinforced throughout their length. Main longitudinal reinforcement in the length of the piles as well as links or spirals shall be provided as shown in the drawings. Longitudinal bars shall preferably be in one length. Reinforced cage shall be handled and installed carefully without damaging its shape. All other requirements of reinforcement bars i.e., quality, workmanship, etc. shall be as specified for reinforced concrete work in Technical Specification for Concrete work.

The average basic length of the piles shown in the drawing/schedule of items is tentative and is to be assumed from cut-off level to the tip of the pile, but the final length will be decided by the Successful bidder with approval of the Engineer on the basis of boring resistance actually observed at site at the particular location. It will be the responsibility of the Successful bidder to prove by subsequent load tests/pull-out tests that the adopted length of the pile shall carry the safe loads, in compression and tension with the resulting deflections being within permissible limits. To ensure this, the length of the pile actually installed will be subject to change if considered necessary from the above mentioned basic length with no extra cost to Owner for deviation in length above or below the stipulated basic length.

The load test must be satisfactory and accepted by the Engineer. If the piles by reasons of defective workmanship or failure of one or more load tests, are found to be unsatisfactory, the test shall be repeated to the satisfaction of the engineer without any extra cost.

3.03.00 Identification of Piles

A plan in triplicate, showing clearly the designation of all piles by an identifying system shall be filed with the engineer before installation of piles is started if so desired by the engineer.

3.04.00 Sequence of Piling

Individual piles and pile groups shall be constructed in such a sequence that the adjacent piles already installed are not disturbed, nor their carrying capacity





reduced by subsequent boring/driving operation. The Successful bidder shall submit the sequence order and programme chart to the Engineer and get his confirmation before starting the work.

3.05.00 Boring

3.05.01 With Casing

Boring equipment and accessories shall generally conform to IS:2911 - relevant section. Boring may be done by either rotary or percussion equipment or grabbing equipment using reversed or direct mud circulation method. In case of unstable soils the boring tools used should be such that suction effects are minimised. Stabilisation of the sides of bore hole shall be done by use of casing. The size of cutting tools shall not be less than the diameter of the pile by more than 75 mm.

The casing should be used from the ground level and shall be kept ahead of boring in case where there is danger of caving-in due to subsoil water entering into the bore hole or where the soil is loose. While boring below subsoil water level, precaution shall be taken so that no boiling of the bottom of the hole occurs due to difference in hydrostatic head.

Boring shall proceed by alternatively driving the casing and extracting the bored material with the boring tools. While boring in soft material liable to cavitation boring tools shall not be operated at a level below the toe of the casing. Care shall be taken to ensure that the volume of water added to the bore shall be not more than the minimum necessary for the operation of the boring tools. The casing shall be driven down through the soft material to penetrate a hard stratum not subjected to cavitation and shall be sealed in this material as far as possible. Thereafter the boring shall be continued by means of the boring tools until the approved bearing layer is reached.

Criteria for approval of the bearing layer will be agreed between the Engineer and the Successful bidder based on visual inspection of recognizable samples, recovered from the pile bore in the upper levels of the compact layer. The approved samples shall consist of sound material shall be consistent in quality for a depth of 300 mm in the pile bore. A sample of this material shall be supplied by the Successful bidder to the Engineer duly labelled for maintaining records of the founding strata.

The piles shall be installed with due consideration for safety of adjacent structures by a method which leaves their strength unimpaired and which develops and retains the required bearing resistance.

Where the soil is such that driving of a pile causes previously installed piles to heave, load test shall be conducted at the expense of the Successful bidder on such pro- portion of the heaved piles which shall be ordered by the Engineer.





3.05.02 With Drilling Fluid

Alternate to the boring with casing, stabilisation of the sides of bore hole can be effected by the use of drilling fluids.

In such cases the drilling fluid must be used at least from the level of subsoil water, as the hole, should then be always kept almost full with the fluid. The density and composition of the fluid shall be such as to suit the requirements of ground conditions and to maintain the fine materials from the boring in suspension. At the last stage of boring or in inter- mediate hard layers chisel or a chopper may be used. The rate for piling work should be inclusive of any chiselling, chopping of hard strata, clearing of bottom of pile borehole etc. complete as per specifications and necessary penetration test as may be required to prove the soundness of the founding strata. A five per cent bentonite suspension would be generally suitable and its quality shall conform to specification given in Appendix 'A' of IS : 2911 (Part-I/Sec.2).

3.06.00 Spacing of Piles

In general, all piles shall have a minimum spacing on centres of $2.5d$ (where 'd' is the diameter of the pile) unless shown otherwise in the drawings.

3.07.00 Placing of Reinforcement

Reinforcement as required shall be made into stiff cages sufficiently wired or welded to withstand handling without any damage or distortion. Reinforcement shall be placed immediately after cleaning and inspection of the bottom of bore holes. The reinforcement should be supported away from the sides of the shaft by means of suitable space block to ensure concentric alignment in the shaft. Steps shall be taken to ensure correct positioning during concreting of reinforcement in the piles without any distortion.

Nominal lap between reinforcement cages shall be 60 cm and the main reinforcing steel shall project for a length sufficient to develop bond (45 times the diameter of reinforcing bar) above the level of the underside of the pile cap.

The concrete cover to main reinforcement shall not be less than 5 cm and suitable spacer blocks shall be provided at intervals not exceeding 2 metres and wired to the main reinforcement.

3.08.00 Concreting

Immediately before concreting the bottom of the hole shall be cleaned very carefully. The cleaning of the hole shall be ensured by careful operation by air lifting process unless otherwise allowed by the Engineer. To lift the spoil at founding level before concreting, borehole shall be agitated by jetting with fresh drilling mud with relatively higher pressure than that used during boring or air through tremie pipe. While boring by use of drilling mud, the specific gravity of the mud suspension in the vicinity of the bottom of the borehole shall be determined by suitable slurry sampler in a first few piles and at suitable interval





of the piles and recorded. Consistency of the drilled mud suspension shall be controlled throughout the boring as well as concreting operation in order to keep the hole stabilized and to avoid concrete mixed up with the thicker suspension of the mud.

Concreting of boreholes shall start as soon as possible after the completion of boring. If a borehole, be left unconcreted for more than two hours, it shall be cleaned thoroughly as directed by the Engineer before concreting. Concrete shall be so placed as to fill the entire volume of the tube or bore without the formation of voids caused by faulty consolidation or entrapped air. Great care shall be taken to ensure that the fluid alluvial soil does not penetrate between batches of the concrete. Concreting under water shall be done in one operation. Concrete shall be placed by means of a tremie pipe. It shall, however, be ensured that concrete entering the tremie pipe does not get mixed up with the slurry and 1/4 kg of granulated vermiculite shall be poured in the tremie pipe before pouring concrete as directed by the Engineer.

3.08.01 Tremie Method of Concreting

The tremie pipes and funnel shall be filled and lifted just 15 cm above bottom before releasing the concrete column to facilitate flushing out the bottom. The concrete levels in the tremie shall be checked every few centimeters in order to note the difference, if any, between the theoretical quantity that should have been placed and actual quantity that has gone in. This is to locate the position of over cut during boring.

In addition to the normal precautions to be taken in tremie concreting as per relevant section of IS:2911 the following specifications shall be particularly applicable for the use of tremie concrete in pipes :

- a) The concrete shall be coherent, rich in cement (not less than 400 kg/m³) and of slump not less than 100 mm.
- b) The hopper and tremie shall be closed system embedded in the placed concrete, through which water cannot pass.
- c) The tremie shall be large enough with due regard to the size of the aggregate. For 20 mm aggregate the tremie pipe shall be of diameter not less than 200 mm, aggregates more than 20 mm shall not be used.
- d) The first charge of concrete shall be placed with a sliding plug pushed down the tube ahead of it or with a steel plate of adequate charge to prevent mixing to concrete and water. However, the plug shall not be left in the concrete as a lump.
- e) The tremie pipe shall always penetrate well into the concrete with an adequate margin if safety against withdrawal of the pipe is required while discharging the concrete.
- f) The pile shall be concreted wholly by tremie and the method of deposition shall not be changed part way up the pile, to prevent the





laittance from being entrapped within the pile.

- g) All tremie tubes shall be scrupulously cleaned after use.

Normally concreting of the piles shall be uninterrupted. In exceptional cases interruption of concreting may be allowed but it will be resumed within 1 or 2 hours. The tremie shall not be taken out of the concrete, instead it shall be raised and lowered slowly, from time to time to prevent the concrete around the tremie from setting. Concreting should be resumed by introducing a little richer concrete with a higher slump for taking care of the partly set concrete in the bore.

If the concreting cannot be resumed before final setting of concrete already placed, the pile so cast may be rejected.

In case of withdrawal of tremie out of the concrete, either accidentally or to remove a choke in the tremie, the tremie may be reintroduced in the following manner to prevent impregnation of laitance or scum lying on the top of the concrete already deposited in the bore.

The tremie shall be gently lowered on to the old concrete with very little penetration initially. A ver- miculite plug shall be introduced in the tremie. Fresh concrete of slump between 150 mm and 175 mm shall be filled in the tremie which will push the plug forward and will emerge out of the tremie displacing laitance/scum. The tremie will be pushed further in steps making fresh concrete sweep away laitance/scum in its way. When tremie is buried by about 60 to 100 cm, concreting may be resumed.

3.08.02 Concreting in Cased Holes

In case of cased holes, after the required founding level is encountered, the bottom shall be sealed with concrete and the reinforcement cage shall be lowered. If the borehole is dry, concrete shall be deposited by direct pour from the top followed by gradual withdrawal of casings. If water is present in the borehole, it shall be bailed out by bailer.

If it is difficult to dewater by the bailer, concrete shall be placed under water by means of a placer. After the head of water has been neutralised by the head of the concrete, excess water shall be bailed out and concrete shall then be deposited by direct pouring from the top, as is done, if the borehole is dry.

Extraction of casing shall be done in such a way that no necking or shearing of the concrete in the shaft takes place.

During the extraction of casing, slumping of concrete shall be observed and when required, additional quantity of concrete shall be poured so that the pile is formed above the cut-off level as per the requirements indicated below.





3.08.03 Cut-off Level

The top of concrete in a pile shall be brought above the cut-off level to permit removal of all laitance and weak concrete before capping and to ensure good concrete at the cut-off level for proper embedment into the pile cap.

Where cut-off level is less than 1.5 m below the working level concrete shall be cast to a minimum of 600 mm above cut-off level. For each additional 0.3 m increase in cut-off level below the working level additional coverage of 50 mm minimum shall be allowed. Higher allowance may be necessary depending on the length of the pile as directed by the Engineer. When concrete is placed by tremie method, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection or to a minimum of one metre above cut-off level. In the circumstances where cut-off level is below ground water level, the need to maintain a pressure on the unset concrete equal to or greater than water pressure shall be observed and accordingly length of extra concrete above cut-off level shall be determined and allowed in Works.

3.09.00 Steel Pipe or Casing tube

This item shall be fabricated with mild steel plates conforming to IS : 2062 and/or steel tubes for structural purpose conforming to IS : 1161 & IS : 1239 as shown on drawings.

Fabrication work and welding of steel shall be done in accordance with IS : 800 and IS : 9595. Welding of pipes shall be done by experienced and good welder who have been qualified by tests in accordance with IS : 817.

3.10.00 Trimming of Pile Heads

Completed piles shall be trimmed to the cut-off levels shown on the drawings or until sound concrete is found to the satisfaction of the Engineer. In the event of trimming being carried below the cut-off level, the pile shall be made upto the correct cut-off level, with concrete of the same quality as used in the piles at the Successful bidder's expense. Reinforcement shall be exposed for the full bond length appropriate to the diameter of the bar and projected in the pile cap. The minimum distance of keying of pile into pile cap shall be 75 mm unless noted otherwise. All concrete and cement shall be removed from the bars, which shall also be wire-brushed to remove any loose, rust, dirt and scale.

Manual chipping shall be permitted after three (3) days of pile casting. Pneumatic chipping, if permitted by the Engineer, shall not be started before seven (7) days.

The concreted length of piles shall be measured from the toe of pile to cutoff level of pile.

Boring of any pile shall not be carried out within a clear distance of three times of the pile diameter from the adjacent pile which has been freshly concreted within past 24 hours.





The contractor shall take all necessary actions to prevent side collapse (if any) of pile bore at his own cost.

The contractor shall be responsible for the prompt removal from the site of all spoil due to the boring to places as indicated by purchaser. The cost of such disposal shall be deemed to have been included in the rate of piling.

Founding Strata

All the piles shall be founded on approved bearing strata or upto specified depth as per design requirement & as mentioned in the drawing.

In general, criteria for approval of founding strata shall be agreed between purchaser & contractor based on visual identification of recognisable samples recovered from pile borehole & specified SPT criteria.

In case, pile is socketted in rock strata, a minimum socketted length of Thrice the pile diameter (3D) shall be provided. The founding rock strata shall be identified by recognisable rock piece sample obtained by boring tool from pile bore &/or wash of rock powder in return water, SPT N > 100 at termination level and as decided by purchaser.

Termination criteria may be standardised / modified at site by purchaser depending on actual sub-surface material encountered and rate of penetration through such strata with the available equipment & accessories.

3.11.00 Lengthening of Piles

Where it is necessary to increase the length of any pile after it has been driven, the head of the pile shall be cut-off to expose the reinforcement for a full bond length of the bars to lap with the new bars. The exposed surface of the concrete shall be hacked to form a key, brushed to remove loose material and covered with 25 mm thick cement mortar (1:2 mix) immediately before the new concrete is placed.

3.12.00 Removal of Spoil

The Successful bidder shall be responsible for the prompt removal from the site of all spoil due to the boring to places indicated by the Engineer. The cost of such disposal shall be deemed to have been included in the Scope.

3.13.00 Back-Filling of Abandoned Borings

The Successful bidder shall backfill all the abandoned borings between the concrete pile and the surface level after setting of concrete of the piles, by sand or by other materials as directed by the Engineer.





All permanently abandoned boreholes generally shall be backfilled with selected materials and for a depth of 5 M below cut-off level with plain concrete of mix M10 so that resistance to lateral forces on neighbouring piles are developed.

3.14.00 Record for Installation of Piles

The Engineer and the Successful bidder shall maintain separate registers, signed jointly by both the parties, giving the following information for each pile or any other proforma as agreed between Engineer and Successful bidder. These data shall be submitted to the Engineer, in triplicate, on completion of installation of each pile.

- a) Date of completion, pile number & sequence of installation of piles in a group.
- b) Bored depth, concreted depth, empty boring and nature of stratum at founding level.
- c) Pile diameter, details of reinforcement and details of mild steel liner where provided along with stiffener.
- d) Volume of concrete poured, time taken, cement bag consumption, slump of concrete and RL of top of concrete.
- e) Time taken for penetration of every 15 cm during last 2 M depth before founding level.
- f) Method of cleaning bottom of hole at founding level before concreting.
- g) Records of additional borings or other subsurface information obtained during the process of boring.
- h) Any other relevant important information.

Any sudden change in the rate of boring which cannot be ascribed to the nature of the ground or any deviation from the designed location, alignment or load carrying capacity of any pile or any upheaval or subsidence noticed on any pile shall be promptly reported to the engineer and adequate corrective measures shall be taken free of any charge as decided by the engineer.

The data for pile load test (load, displacement, time, etc.) are to be recorded sequentially for the test under consideration in a suitable proforma as agreed between Engineer and Successful bidder. These data along with the load-displacement curve shall be submitted to the Engineer, in triplicate, on completion of each load test.





3.15.00 Defective Piles

Any pile which is shown to be defective under load test shall not be accepted and the Engineer will relate such failure to the acceptance of other piles in the area.

If an individual pile should fail to meet the requirements specified, such piles may be deemed to be defective and the Engineer may order such investigation to be made as he considers appropriate.

When any pile is found defective, the Successful bidder shall perform at his own expense one or more of the following remedial measures as directed by the Engineer.

- i) Replacement of defective piles.
- ii) Providing additional piles.
- iii) Alteration in design of pile caps.

3.16.00 Idle Period

The phasing of construction and movement of plant shall be done as desired by the engineer. The phasing may involve some extra movement of the plant or some idle period, but the successful bidder will not be entitled to any claim due to this reason.

3.17.00 Test Pile

The successful bidder may have to construct test piles, if desired by the engineer, before he starts systematic piling operation at locations indicated. For this purpose, the pile construction process shall be the same as in usual piling process to be followed on this job. Load test on such piles shall be as per the provisions under "Procedure for Initial Load Test" in IS : 2911 (Part - IV) or as directed by the engineer.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

The successful bidder shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in the contract. Whenever directed, the successful bidder shall get the specimens tested in a laboratory approved by the engineer and submit to the engineer test results in triplicate within three (3) days of completion of the test.





4.02.00 Components of RCC

The testing and acceptance criteria for components of reinforced cement concrete shall be as stipulated in the relevant clauses of the Technical Specification for Cement Concrete (Plain and Reinforced).

4.03.00 Components of Steel

Testing and acceptance criteria for the component of steel pipe material and fabrication work shall be as stipulated in relevant clauses of IS : 800 and IS : 9595.

4.04.00 Load Tests

4.04.01 General

Initial tests and/or routine tests as indicated in the FQP or as directed by the engineer shall be carried out on single pile or pile groups to ascertain the capacities of the piles and their behaviour.

Any or all of the tests described below shall be carried out as indicated in the FQP or as directed by the engineer. The tests shall be performed as per requirements of the relevant Indian Standards and as supplemented herein.

4.04.02 Vertical Load Test [as per IS : 2911 (Part-IV)]

Load tests shall be carried out on single piles to check the bearing capacity or the quality of piles in the manner specified below :

From among the completed piles the Engineer at his discretion shall select piles for the purpose of testing.

At least 1% of the piles driven shall be tested to an overload of 50% above the working load of the pile and 0.1% of the piles driven shall be tested to an overload of 100% above the working load of the pile.

Load shall be applied in increments of about one-fifth of the design load till the design load is reached and thereafter in increment of 10 tonnes till the test load is reached.

Each increment of load shall be maintained for minimum of half an hour upto design load and thereafter for one hour till the test load is reached. Test load shall be maintained for 24 hours.

For each increment of load, readings of settlement at every ten minutes shall be taken. The next increment of load shall be applied only when the difference in settlement of readings between the last two readings does not exceed 0.02 mm. On application of test load, readings shall be taken at every hour.

Unloading will be done in following decrements of load :





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- i) Test load to design load
- ii) Design load to 50% of design load
- iii) 50% of design load to 25% of design load
- iv) 25% of design load to complete unloading

Each decreased load shall be kept for a minimum of half an hour and readings of rebound taken every ten minutes. The next decrement shall be applied only when the difference in readings between the last two readings is less than 0.02 mm.

The observation and recording of settlement and rebound shall be done simultaneously by the Successful bidder and the Engineer's representative. Three copies of all the readings for the test shall be supplied by the Successful bidder to the Engineer-in-charge. Actual proforma for recording the results shall be proposed by the Successful bidder and approved by the Engineer-in-charge before the start of the load test.

The pile shall be deemed to be acceptable if the gross settlement at the test load of one and a half times the designed load does not exceed 0.01" per tonne of test load or 1/2" (12 mm) whichever is less.

In case a pile fails under or during the load test, the Engineer shall select two additional piles in lieu of each of such piles failed and the Successful bidder shall carry out load tests on these piles in the same way as the load tests on the original piles at his own cost. This procedure will be repeated in the case of each failure of pile under/during load test.

The Successful bidder shall arrange at his own expense sufficient amount of knowledge for loading well in advance of the commencement of the load test.

Detailed proposal together with a sketch for the load test arrangement shall be furnished by the Successful bidder to the Engineer-in-charge for checking and approval.

The pile head shall be chipped off to natural horizontal plane till sound concrete is met. The projecting reinforcement shall be cut-off or bent suitably and the top finished smooth and level. A bearing plate with a hole at the centre shall be placed on the head of the pile for the jacks to rest.

Jacks used in any particular load test should be of the same capacity and their number shall be limited to two only. They should preferably be connected and operated by one pump. The Successful bidder shall submit certificates certifying the correctness of the calibrations of the pressure gauges and jacks before use. All jacks should be fitted with locking devices. Settlement and rebound shall be recorded by minimum two (2) deflectometers of 0.01 mm sensitivity and also by other independent means of direct measurement.





Deflectometers shall be supported independently and in such a way as to be not affected by the settlement of the piles.

4.04.03 Lateral Load Test

The test shall be carried out by introducing hydraulic jack with gauge between two piles under test or the reaction shall be suitably obtained otherwise. When the test is conducted by jack located between two piles, the full load imposed by the jack shall be taken as the lateral resistance of each pile.

Load shall be applied in increments of about one-fifth of the design load. The next increment shall be applied after the rate of displacement is nearer to 0.1 mm per 30 minutes. Displacement shall be read by using at least two (2) deflectometer of 0.01 mm sensitivity spaced by 30 cm and kept horizontally one above the other or by any means as per IS-2911 (Part-4) or as approved by the Engineer. The safe lateral load on pile shall be taken as the least of the followings :

- a) Fifty percent (50%) of the final load at which displacement increases to 12 mm.
- b) Final load at which the total displacement corresponds to 5 mm.

4.04.04 Pull-out Test

The test shall be carried out to an overload of fifty percent (50%) of the estimated safe load or a displacement of 12 mm total whichever is earlier.

Uplift force may preferably be applied by means of hydraulic jack(s) with gauge using a suitable pull-out set up as per IS-2911 (Part-4) or as approved by the Engineer.

The pull-out load increments and consequent displacement readings shall be same as in the case of Vertical Load Test.

The safe load shall be taken as the least of the followings :

- a) Two-thirds of the total load at which the load-displacement is 12 mm.
- b) Half the load at which the load-displacement curve shows a clear break (downward trend).

4.05.00 Non-destructive Dynamic Test on Working Piles

4.05.01 "Low Strain" Method for Integrity Investigation of Concrete Piles :

The method of testing shall conform to ASTM D 4945.or equivalent Indian Standards.





All equipments e.g., small impact device 16 lbs. nylon tipped hand held hammer, accelerometer, pile integrity tester & pile driving analyser shall be arranged by the Successful bidder. Analysis shall be carried out by exponential amplification of the signal with time and the average velocity curve obtained by numerically integrating the acceleration record to be submitted. From analysis of the results any defect like necking, honey-combing, segregation or weakness in concrete, when detected shall be reported in detail.

4.05.02 "High Strain" Method for Determining of Pile Capacity

The method of testing shall conform to ASTM D 4945 or equivalent Indian Standards.

All equipment including piezoelectric transducers, strain gauges, pile driving analyser, two track oscilloscope for displaying data and analog tape recorders for recording data shall be arranged by the successful bidder. For every hammer below, the analyser shall determine the following data :

- i) Pile bearing capacity
- ii) Transferred energy
- iii) Maximum compression force
- iv) Maximum tension force
- v) Maximum impact velocity
- vi) Maximum acceleration
- vii) Maximum displacement

which are to be properly recorded and analysed and submitted in a detailed report form.

4.06.00 Acceptance Criteria

The piles shall be accepted as satisfactory only when the work has been executed in accordance with this specification to the satisfaction of the Engineer and the standards stated hereinafter.

- a) The head of the pile shall be within 75 mm of the specified position on the drawings.
- b) The pile shall not be out of plumb by more than two percent.
- c) The toe of the pile shall be at the approved bearing level in each case.
- d) The total volume of concrete shall not be less than 20% and not more than 50% greater than the calculated volume. The calculated volume for





this purpose shall be the cross-sectional area inside the casing multiplied by the length of the shaft. The concrete shall show the specified strength as indicated by the cube test results.

- e) The results of the load tests incl. non- destructive dynamic test carried out in accordance with the contract and with the specifications shall be satisfactory.
- f) In case of single pile the positional tolerance shall not be more than 50 mm.

4.07.00 Lateral Dynamic Load Test on Piles

Two types of tests, namely, free and forced vibration lateral tests shall be carried out to observe response of soil-pile system under horizontal dynamic loads and for the evaluation of soil-pile stiffness, soil modulus, natural frequency, time period and damping characteristics of soil-pile system.

A minimum of three representative piles of same type in almost similar soil conditions shall be tested. Two adjacent piles shall be subjected first to free vibrations and then to forced vibrations, the third pile shall only be tested under forced vibrations.

The equipment and accessories for the test, setting up and test procedure and recording of observations shall be as described in relevant sections of IS : 9716 (Guide for Lateral Dynamic Load Test on Piles). The tests shall normally be carried out without sustained vertical load other than that of the oscillator assembly. However, sustained weight can be used to increase dynamic force to obtain resonance or nearly resonance condition.

From analysis of test data, the following parameters shall be determined:

- i) Frequency of vibrations
- ii) Amplitude of vibrations
- iii) Imparted dynamic force
- iv) Natural frequency
- v) Damping coefficient
- vi) Soil-pile stiffness
- vii) Coefficient of horizontal soil modulus variation

5.00.00 INFORMATION TO BE SUBMITTED

5.01.01 Design Data





The successful bidder shall submit full details of the method of construction, design data and drawings for the type of piles he wishes to adopt.

5.01.02 Programme of Construction

The successful bidder will also submit the details of the construction equipment that he will employ. A proposed construction programme, matching with the capacity of the equipment and taking into consideration the various idle and non production periods on account of shifting of equipment, testing and possible delays due to modifications of design should be drawn up, keeping in view the completion dates stipulated in the tender.

5.02.00 After Award

After award of the contract, the successful bidder is to submit the following details :

5.02.01 Execution Plan

The successful bidder will submit six (6) copies of drawings showing the sequence of piling. The drawings will be prepared on the basis of a master plan giving identification number of the piles, which will be furnished by the engineer.

5.02.02 Detailed Construction Programme

A detailed construction programme for completion of the work is to be submitted. This master programme will be reviewed and updated every month or at more frequent intervals as directed by the engineer, incorporating the various factors that have caused or are likely to cause changes in the programme.

5.02.03 Requirement of Materials, Tools and Plants and Equipment

In accordance with the master programme, a detailed material, tools and plants and equipment requirement schedule, particularly for those items which the bidder is to supply as per the terms and conditions of contract is to be submitted.

5.02.04 Test Results

The test data and results for the various items like welding of pipes, ingredients of RCC, concrete cubes and cylinders, driving of the shell, static load tests on single piles and pile groups and dynamic tests on working pile will be submitted regularly and as and when directed by the engineer.





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VOLUME: II-B

SECTION: I

PART: A

SUB SECTION: VI

**GUIDELINE
FOR
FABRICATION OF STRUCTURAL STEEL WORK**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part A; Sub Section: VI
Fabrication of Structural Steel Work



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**GUIDELINE
FOR
FABRICATION OF STRUCTURAL STEELWORK**

1.00.00 SCOPE

This specification covers supply of all raw steel materials, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork in general covered under the scope of the contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Successful Bidder

The work to be provided for by the Successful Bidder, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following :

- a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on Successful Bidder's design drawings approved by the Consultants.
- b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.
- c) To submit design calculations for joints and connections developed by the Successful Bidder along with detailed fabrication drawings.
- d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections. The field connection materials supplied by the Successful Bidder shall be in adequate quantity to avoid delay in erection.
- e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.





- f) Suitably mark, bundle and pack for transport all fabricated materials.
- g) Prepare and furnish Drawing Office Despatch lists, Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.
- h) Insure, load and transport all fabricated steelwork field connection materials to site.

2.02.00 Work by others

No work under this specification shall be provided for by any agency other than the Successful Bidder, unless specifically mentioned otherwise elsewhere in the contract.

2.03.00 Codes and standards

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard Specification, any other standard practice, as may be specified by the Engineer shall be followed:-

LIST OF I.S. CODES - RELEVANT TO FABRICATION OF
STRUCTURAL STEEL WORK

IS Codes	Description
IS : 800 -	Code of practice for general construction in steel.
IS : 801 -	Code of practice for use of cold formed light gauge steel structural members in general building construction.
IS : 806 -	Code of practice for use of steel tubes in general building construction.
IS : 808 -	Dimensions for rolled steel beams, channels and angle sections.
IS : 812 -	Glossary of terms relating to welding & cutting of metals.
IS : 813 -	Scheme of symbols for welding.
IS : 814 -	Covered electrodes for metal arc welding of carbon and carbon manganese steel.





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- IS : 815 - Classification coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
- IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel.
- IS : 817 - Code of practice for training & testing metal arc welders.
- IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations.
- IS : 819 - Code of practice for resistance spot welding for light assemblies in mild steel.
- IS : 822 - Code of practice for inspection of welds.
- IS : 919 - Recommendations for limits and fits for engineering.
(Part - 1&2)
- IS : 1161 - Steel Tubes for structural purposes.
- IS : 1182 - Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
- IS : 1200 - Method of measurement of steel work and iron work
(Part - 8)
- IS : 1239 - Mild steel tubes, tubulars and other wrought steel fittings
(Part - 1&2)
- IS : 1363 - Hexagon head bolts, screws and nuts of product grade C.
(Part - 1 to 3)
- IS : 1364 - Hexagon head bolts, screws and nuts of product grade A & B.
(Part - 1 to 5)
- IS : 1365 - Slotted counter sunk head screws (dia. 1.6 to 20 mm)
- IS : 1367 - Technical supply conditions for threaded steel fasteners.
(Part - 1 to 18)
- IS : 1608 - Method for tensile testing of steel products.
- IS : 1730 - Dimensions for steel plate, sheet and strip for structural and general engineering purposes.





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- IS : 1852 - Rolling and cutting tolerances for hot-rolled steel product.
- IS : 1977 - Structural steel (Ordinary quality)
- IS : 2016 - Plain washer
- IS : 2062 - Steel for general structural purposes.
- IS : 2629 - Recommended practice for hot-dip galvanising of iron and steel.
- IS : 2633 - Method for testing uniformity of coating on zinc coated articles.
- IS : 3644 - Code of practice for ultrasonic pulse echo testing by contact and immersion method.
- IS : 3757 - High Strength Structural Bolt
- IS : 4000 - High strength bolts in steel structure
- IS : 4759 - Specifications for hot-dip zinc coatings on structural steel and other allied products.
- IS : 4923 - Hollow steel sections for structural use.
- IS : 5334 - Code of practice for magnetic particle flaw detection of weld.
- IS : 5369 - General requirements for plain washers and lock washer.
- IS : 6005 - Code of practice for phosphating of iron and steel.
- IS : 6649 - Specification for hardened and tempered washers for high strength structural bolts and nuts.
- IS : 6623 - Specification for high strength structural nuts.
- IS : 7215 - Tolerances for fabrication of steel structures.
- IS : 7280 - Bare wire electrode for submerged arc welding.
- IS : 8500 - Structural steel micro alloyed (medium & high strength quality).
- IS : 8629 - Code of practice for protection of iron and (Part - I to III) steel structures from atmospheric corrosion.





- IS : 9595 - Recommendation for metal arc welding of carbon manganese steels.
- PAINTING
- IS : 117 - Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes.
- IS : 128 - Specification for ready mixed paint, brushing, finishing, semi-gloss for general purposes, black.
- IS : 1477 - Code of practice for painting of ferrous metal in building.
(Part - I & II)
- IS : 2074 - Ready mixed paint, air-drying red-oxide zinc chrome priming.
- IS : 2339 - Specification for aluminium paints for general purposes in dual container.
- IS : 2932 - Specification for enamel, synthetic exterior type - I.
- IS : 2933 - Specification for enamel, synthetic exterior type - II.

2.04.00 Conformity with Designs

The Seller shall design all connections and supply all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Consultant keeping in view the maximum utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Consultant.

Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.05.00 Materials to be used

2.05.01 General

All steel materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the Owner / Consultant. If desired by the Owner/Consultant, Test Certificates of materials supplied by the Seller in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Owner / Consultant, a random sample shall be tested at an approved laboratory from each lot of 50 tonnes or less of any particular section.





The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.05.02 Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable :

- 1) IS : 801 - Cold formed light gauge steel structural member.
- 2) IS : 806 - Steel tubes in general building construction.
- 3) IS : 1161 - Steel tubes for structural purpose.
- 4) IS : 1977 - Structural steel (Ordinary quality)
St-42-0
- 5) IS : 2062 - Steel for general structural purpose
- 6) IS : 8500 - Structural steel-micro alloyed (Ordinary & high strength quality)

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.05.03 Electrodes

All electrodes to be used under the Contract shall comply with any of the following Indian Standard Specifications as may be applicable:

- 1) IS : 814 - Covered electrodes for metal arc welding structural steel
- 2) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
- 3) IS : 7280 - Base wire electrode for submerged arc welding.

2.05.04 Bolts and Nuts





All bolts and nuts shall conform to the requirements of Indian Standard Specification IS:1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel : All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 /A, where 'A' is the cross sectional area of the test specimen : -

1) IS:1367 - Technical supply conditions for threaded fasteners.

2) IS:1608 - Method for tensile testing of steel other than sheet, strip, wire and tube.

b) High Tensile Steel : The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS:1367 or as approved by the Consultant.

c) High Strength Friction Grip Bolt : HSFG Bolts shall be high tensile of 20 mm dia or higher diameter and of property class 8.8 (minimum) as per IS – 1367 (Latest) for all major connection. All bolts, nuts and washers shall be procured from the approved manufacturers. The bolted joints shall be designed for friction type connection and the HT bolts shall be tighten to develop the required pretension during their installation.

2.05.05 Washers

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract :

1) IS : 1977 - Structural steel (Ordinary Quality) St-42-0

2) IS : 2062 - Steel for general structural purpose





- 3) IS : 8500 - Structural steel - micro alloyed (medium& high strength quality)
- 4) IS : 6623 - High Strength Structural Nuts
- 5) IS : 6649 - Hardened and tampered washers for high strength structural bolts & nuts.

2.05.06 Paints

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS:2074 - Ready mixed Paint, Air Drying, Priming as mentioned elsewhere in this specification.

2.06.00 Storage of Material

2.06.01 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the Successful Bidder's yard immediately, failing which, the Consultant shall be at liberty to get the material removed. The Successful Bidder shall maintain upto date accounts in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in Successful Bidder's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.06.02 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section-wise and lengthwise so that they can be easily inspected, measured and accounted for at any time. If required by the Owner /Consultant, the materials may have to be stored under cover and suitably painted for protection against weather.

2.06.03 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.06.04 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be





stored in separate gunny bags or compartments according to diameter, length and quality.

2.06.05 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.07.00 Quality Control

The Successful Bidder shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with QA/QC plan included as Appendix H. In addition to the Successful Bidder's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Consultant or Consultant's representative. As far as possible, all inspection by the Owner / Consultant shall be made at the Successful Bidder's fabrication shop whether located at Site or elsewhere. The Successful Bidder shall cooperate with the Owner / Consultant in permitting access for inspection to all places where work is being done and in providing all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Successful Bidder.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work:

- a) Steel : Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
- b) Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.
- c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.
- d) Welders : Qualifying Tests
- e) Welding sets : Performance Tests
- f) Welds : Inspection, X-ray, Ultrasonic tests
- g) Paints : Manufacturer's certificate, physical inspection reports





- h) Galvanizing : Tests in accordance with IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.08.00 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.09.00 Shop Drawings

The Successful Bidder shall submit to the site-in-charge, the Schedule of Fabrication and delivery of structural steelwork. He shall start to submit progressively for approval the shop drawings based on the approved Design Drawings and before proceeding with the fabrication work.

The sequence of submission of shop drawings shall match with the approved fabrication and delivery schedule. The shop drawings shall be in general conformity with the design requirements as well as specification and shall ensure the correctness of general arrangement for centreline dimensions and levels, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, weld length, size of gusset/end plates.

The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. shall be entirely the Successful Bidder's responsibility.

The shop drawings shall include but not be limited to the following: -

- a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
- b) Dimensional drawings of base plates, foundation bolt location etc.
- c) Details of all connections with supporting calculations.
- d) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.
- e) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.
- f) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.





The shop drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with the provisions of this Specification. Shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between shop and field bolts and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked-up stresses and distortion.

Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification --IS:813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Successful Bidder shall be responsible for any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him.

3.00.00 WORKMANSHIP

3.01.00 Fabrication: Fabrication may be either shop fabricated or Site fabricated.

3.01.01 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS:800 - Code of Practice for use of Structural Steel in General Building Construction and other relevant Indian Standards.

3.01.02 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS:1852 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.

3.01.03 Cutting

Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch may be permitted for mild steel





only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Consultant.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which shall be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges. Occasional notches or gauges not more than 4 mm deep shall be permitted. Gouges greater than 4 mm, that remain from cutting, shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.01.04 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Consultant.

3.01.05 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided.

3.02.00 Bolted construction

All bolted connections shall have a minimum of 2 bolts with c/c distance limited to minimum spacing as per IS: 800.

3.02.01 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the bolt is less or more than or equal





to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for bolts shall not be formed by gas cutting process.

3.02.02 Assembly

Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Consultant.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings. For base plates at any level, the minimum thickness of the washer plate shall be 0.8 times of base plate thickness.

3.03.00 Welded Construction

3.03.01 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS:817.

3.03.02 Preparation of Material





Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.

3.03.03 Assembling

Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2 Deg.).

The work shall be positioned for flat welding whenever practicable.

3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as shall avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Consultant, welded assemblies shall be stress relieved by heat treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Consultant.

3.03.05 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and





weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that shall ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the Contract.

Minimum size of fillet weld based on thickness of thicker element connected shall be

- (a) 6 mm for plate up to 20mm thick
- (b) 8 mm for 21 to 30 mm thick
- (c) 10 mm for 31 to 50 mm thick
- (d) 12 mm for 51mm & above

All members shall be welded to the gusset for full contact length available.

Minimum fillet weld thickness for site welds shall be 8 mm with plates of thickness more than 8 mm.

Spacer plates for double and starred angle members shall be provided at a spacing of not more than 40 r (min) for compression elements and 80 r(min) for tension elements, where r (min) is r_{xx} and r_{yy} of the single angle respectively.

All gussets shall be of minimum 8mm thick. In the drawings thickness of gusset plate corresponding to forces in members shall be

- (a) 8 mm gusset plate for forces up to 15 tonnes.
- (b) 10 mm gusset plate for forces 16 – 25 tonnes.
- (c) 12 mm gusset plate for forces 26 – 40 tonnes.
- (d) 14mm gusset plate for forces 41-60 tonnes.
- (e) 16 mm gusset plate for forces 61 - 80 tonnes.
- (f) 18 mm gusset plate for forces 81 - 100 tonnes.
- (g) 20 mm gusset plate for forces 101 ton and above.

To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.03.06 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5 Deg. C. However, if welding is to be undertaken at low





temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5 Deg. C and 0 Deg. C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is handwarm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20 Deg. C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.03.07 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.03.08 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be accepted by the Owner.

3.04.00 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm.

3.05.00 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3.06.00 Lacing bars





The ends of lacing bars shall be neat and free from burrs.

3.07.00 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.08.00 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.09.00 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.10.00 Shop connections

- a) All shop connections shall be welded as specified on the Drawings.
- b) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the Successful bidder will have to make the desired changes.

3.11.00 Castings

Steel castings shall be annealed

3.12.00 Shop erection

3.13.00 The steelwork shall be checked for accuracy of fit before despatch..
Shop painting

3.13.01 General

Unless otherwise specified, steelwork which shall be concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given final coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Consultant.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other mechanical cleaning methods to remove loose mill scale, loose rust,





weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush.

After completion of the pre-cleaning, the metal surface shall immediately be painted with primer as per .cl 3.18.00/vol II B/sec –I/Part C/SS III

In highly corrosive environment, all steelwork shall be given a coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned by sand blasting to SA 2/1/2 grade minimum. The shop paint shall be as per .cl 3.18.00/vol II B/sec –I/Part C/SS III

3.13.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.13.03 Contact surfaces

Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly.

3.13.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.13.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.14.00 Galvanizing

3.14.01 General

Structural steelwork for structures if specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanising of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.





3.14.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, dirt, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.14.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport and handling. Damages, if occur, shall be made good in accordance with the provisions of this Specification or as directed by the Owner/Consultant.

4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.01.00 Inspection

Unless specified otherwise, inspection to all work shall be made by the Owner /Consultant at the place of manufacture prior to delivery. The Owner /Consultant shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities





for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Successful Bidder shall provide such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Owner/Consultant to carry out inspection and/or tests in accordance with the Contract.

The Successful Bidder shall guarantee compliance with the provisions of this Specification.

4.02.00 Testing and Acceptance Criteria

4.02.01 General

The Successful Bidder shall carry out sampling and testing in accordance with the relevant Indian Standards and as required by the owner/consultant.

The Successful Bidder shall get the specimens tested in a laboratory approved by the Owner /Consultant and submit to the Consultant the test results in triplicate within 3 (three) days after completion of the test.

4.02.02 Steel

All steel supplied by the Seller shall conform to the relevant Indian Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance.

Steel shall conform to IS: 2062 (latest) for rolled structural steel members.

4.02.03 Testing Criteria for checking Lamination in raw steel plates

All raw steel plate of thickness more than 20 mm supplied by the Seller shall be checked against lamination before procurement & prior to commencement of fabrication work in the following ways as directed by the Consultant.

- a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any.
- b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Consultant.





If the results of the above tests are not satisfactory, the plates shall not be taken up for fabrication work. Even after fabrication at shop, if the Consultant requires any ultrasonic testing to detect lamination of plates, the same shall be carried out by the Successful Bidder. If the plates in the fabricated item are found to be laminated, the component shall be rejected.

4.02.04 Welding

All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tonnes of welded fabrication, the Owner/Consultant may ask for at least 1 (one) test-destructive or non-destructive including X-ray, ultrasonic test or similar. In the event of further tests as may be desired by the Owner/Consultant, if the results are found to be unsatisfactory; and if the test shows no defect. In cases of the test results showing deficiency, the Owner/Consultant shall have option to reject or instruct any remedial measures to be taken.

4.02.05 Bolts, nuts and washers

All bolts, nuts and washers shall be procured from reputed manufacturer accepted by the Owner and shall conform to the relevant Indian Standards. If desired by the Owner, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards.

4.02.06 Shop painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.02.07 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.03.00 Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS:1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures other than steel railway & road bridges, structures subjected to dynamic loading (like wind,





seismic etc.) and thin walled construction (like box girders) shall be as specified in IS:7215 - Tolerances for Fabrication of Steel Structures.

4.04.00 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Owner/Consultant considers the defects rectifiable. The Owner/Consultant may, at his discretion, check the test results obtained at the Successful Bidder's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory.

When all tests to be performed in the Successful Bidder's shop under the terms of this contract have been successfully carried out, the steelwork shall be accepted forthwith and the Owner/Consultant shall issue an acceptance certificate, upon receipt of which, the items shall be shop painted, packed and despatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.05.00 Delivery of materials

4.05.01 General

The Successful Bidder shall deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as shall permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.05.02 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as shall further facilitate identification and erection.

4.05.03 The Successful bidder shall submit periodic test reports of all materials procured and used such as raw steel, paints, electrodes, colour coated sheets, poly carbonate sheets, sheeting fixtures, bolts, nuts & washers etc. The test reports shall indicate conformance to specifications / IS codes etc.

The Successful bidder shall submit test reports for all welds carried out at shop such as UT and RT reports, shall also be submitted along with each inspection call, covering structures offered for inspection.





DFT record of paint applied measured at random covering structures offered for inspection.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 NOT USED

5.02.00 After Award of Contract

After award of the Contract the Successful Bidder is to submit the following:

- a) Complete fabrication drawings, material lists, cutting lists, bolt lists, field welding schedules based on the design drawings in accordance with the approved schedule.
- b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Owner/Consultant on or before the 7th day of each month, giving the up to date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.
- c) Results of any test as and when conducted and as required by the Owner/Consultant.
- d) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.



Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: A

SUB SECTION: VII

**GUIDELINE
FOR
ERECTION OF STRUCTURAL STEELWORK**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part A; Sub Section: VII
Erection of Structural Steel Work



**Tender Specification
for
Chimney**

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**VOLUME: II-B
SECTION: I**

PART: A

SUB SECTION: VII

**GUIDELINE
FOR
ERECTION OF STRUCTURAL STEELWORK**

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at Site and installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the SuccessfulBidder

The work to be provided for by the SuccessfulBidder, unless otherwise specified in the Contract, shall include but not be limited to the following:-

- a) The Bidder shall provide all construction materials and the SuccessfulBidder shall provide all transport equipment, tools, tackle, consumables, materials, labour and supervision required for the erection of the structural steelwork.
- b) Receiving, unloading, checking and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site.
- c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Owner/Consultant. If necessary, suitable temporary approach roads to be built for transportation of fabricated steel structures.
- d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets any defect observed in the foundation shall be brought to the notice of the Owner/Consultant. The SuccessfulBidder shall fully satisfy himself





regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.

- e) Aligning, plumbing, levelling, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Owner/Consultant.
- f) Painting of the erected steel structures if required by the Contract.
- g) All minor modifications of the fabricated steel structures as directed by the Owner/Consultant including but not limited to the following:
 - i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
 - ii) Cutting, chipping, filling, grinding etc. if required for preparation and finishing of site connections.
 - iii) Reaming of holes for use of higher size bolt if required.
 - iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication. Welding in place of bolting shall be permitted only at the discretion of the Owner/Consultant.
 - v) Refabrication of parts damaged beyond repair during transport and handling or Refabrication of parts which are incorrectly fabricated.
 - vi) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.
 - vii) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
 - viii) Carry out tests in accordance with this Specification if directed.

2.02.00 Work by others

No work under this Specification shall be provided for by any agency other than the Successful Bidder unless specifically mentioned elsewhere in the Contract.

2.03.00 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:-

IS-800 : Code of Practice for general construction in steel





- IS-456 : Code of Practice for plain or reinforced concrete
IS-7205 : Safety Code for erection of Structural Steel work
IS-12843 : Tolerance for erection of Steel Structures

2.04.00 Conformity with designs

The SuccessfulBiddershall erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the design criteria detailed in the approved erection drawings and/or other stated document. All work shall conform to the provisions of the relevant Indian Standard Specifications and/or the instructions of the Owner/Consultant. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and/or the instructions of the Owner/Consultant.

2.05.00 Material

2.05.01 General

The SuccessfulBiddershall check the quantity, quality and the sizes of the fabricated materials and verify the adequacy of the same in accordance with the Drawings and Specifications. The SuccessfulBidder shall make good any deficiency, if detected, either by repair or with fresh material as may be directed by the Owner/Consultant.

All consumables like oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other material that may be required for the execution of the works in accordance with the contract shall be supplied by the SuccessfulBidder for erection work and shall be deemed to have been included in this rates.

2.05.02 Materials to conform to Indian Standards

All materials required to be supplied by the Seller under this Contract shall conform to the relevant Indian Standard Specifications.

2.06.00 Storage of materials

2.06.01 General

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the Owner/Consultant shall be at liberty to get the materials removed by agency.

2.06.02 Yard





The Successful Bidders shall have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other materials which shall be delivered to him by the Owner according to the Contract. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipments.

The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work.

2.06.03 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built.

2.07.00 Quality Control

The Successful Bidder shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Owner/Consultant to assure compliance with the provisions of the Contract and shall submit the records of the same to the Owner/Consultant. The quality control operation shall include but not be limited to the following items of work:-

- 1) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- 2) Grouting : Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout.
- 3) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

The Successful Bidder shall salvage, collect and deliver all the packing materials to the Owner.

3.00.00 WORKMANSHIP

3.01.00 Erection

3.01.01 Plant and equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition and shall have the approval of the Owner/Consultant.





3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Erector shall arrange for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract.

3.01.03 Temporary bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

The responsibility of the Successful Bidder in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Owner/Consultant.

3.01.04 Temporary floors for buildings

It shall be the responsibility of the successful bidder to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or by-laws of state, Municipal or other local authorities.

3.01.05 Setting out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Owner/Consultant. Anchor bolts and other anchor steel shall be embedded by other agencies. The Successful Bidder shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the Successful Bidder shall set proper screed bars if desired by the Owner/Consultant, to maintain proper level.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification.

No permanent field connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained.

3.01.06 Field bolting





All relevant portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following :

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into good contact with each other. "snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-1 with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE - I

Bolts length not exceeding 8 x dia. or 200 mm	Bolt length exceeding 8x dia. or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation - 30 over or under.

Bolts may be installed without hardened washers when tightening is done by the turn-of-nut method. However, normal washers shall be used.





Bolts tightened by the turn-of-nut method may have the outer face of the nut match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE - II. Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE - II

Nominal Bolt Diameter (mm)	Torque to be applied (Kg.M) for bolt class 8.8 of IS : 1367
20	59.94
22	81.63
24	103.73

NOTE :

The above torque values are approximate for providing tensions of 14.7 MT for 20 mm dia., 18.2 MT for 22 mm dia; and 21.2 MT for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular torque wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to





be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.01.07 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.01.08 Holes, cutting and fitting

No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done unless specifically approved and/or instructed by the Owner/Consultant.

The Successful Bidder shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract or directed by the Owner/Consultant. Wherever such work is specified the Successful Bidder shall obtain complete information as to size, location and number of alterations prior to carrying out any work.

3.02.00 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Owner/Consultant and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.03.00 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Grouting shall be carried out with Ordinary Cement grout as described below:

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert





supervision, taking care to avoid air-locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Owner/Consultant or shown on the drawings.

Admixtures like aluminium powder, "ironite" may be required to be added to the grout to enhance certain desirable properties of the grout.

It is preferable that the grouting may be done with non-shrink high strength free flow cementitious grout (ready mixed) like "Sika grout - 214", or "Anchor NSG" or approved equivalent.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

3.04.00 Painting after erection

Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Owner/Consultant. However, touch up paintings, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Successful Bidder. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project.

Painting shall not be done in rainy or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field bolts, welds and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which shall be in contact after site assembling shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface which will be inaccessible after field assembly shall receive the full specified protective treatment before assembly. Bolts and fabricated steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project.





The number of coats and the shades to be used shall be as specified or as directed by the Owner/Consultant.

3.05.00 NOT USED

3.06.00 Final cleaning up

Upon completion of erection and before final acceptance of the work by the Owner/Consultant, the SuccessfulBidder shall remove all falsework, rubbish and all Temporary Works resulting in connection with the performance of his work.

3.07.00 Safety Measures during Erection

The safety measures to workmen and supervisors during all types of erection work (e.g., use of lifting appliances, slinging, welding, gas cutting, etc.) should be taken as per IS : 7205. When any statutory provisions exist, the same shall be complied with in addition to the provisions contained in the above code.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

Loading tests shall be carried out on erected structures, if required by the Owner/Consultant, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good by the SuccessfulBidder responsible, to the satisfaction of the Owner/Consultant.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following Sub-clauses 4.1.1, 4.1.2 and 4.1.3. The method of testing and application of loading shall be as approved by the Owner/Consultant.

4.01.01 Stiffness Test

In this test, the structure or member shall be subjected, in addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after





this second test is not less than 90 percent of the maximum increase in strain or deflection recorded during the second test.

4.01.02 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole.

Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.01.03 Structure of same design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 times the specified live load, in a manner and to an extent prescribed by the Owner/Consultant. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.1.1. here-in-before.

4.02.00 Tolerances





Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steelwork applicable to this Project and as specified below :

Component	Description	Variation Allowed
I)	For Buildings Containing Cranes	
i)	Main columns	
	a)	Shifting of column axis at foundation level with respect to building line
	i)	In longitudinal direction
	ii)	In lateral direction
		i) ± 3.0 mm
		ii) ± 3.0 mm
	b)	Deviation of both major column axis from vertical between foundation and other member connection levels :
	i)	For a column upto and including 10M height
	ii)	For a column greater than 10M but less than 40M height
		i) ± 3.5 mm from true vertical
		ii) ± 3.5 mm from true vertical for length measured between connection levels, but not more than ± 7.0 mm per 30 m length
	c)	For adjacent pairs of columns across the width of the building prior to placing of truss.
		± 9 mm on true span.
	d)	For any individual column deviation of any bearing or resting level from



			levels shown on drawings.	± 3.0 mm
		e)	For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating level supposed to be at the same level.	3 mm
ii)	Trusses	a)	Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord	1/1500 of the span or not greater than 10 mm whichever is the least
		b)	Lateral displacement of top chord at centre of span from vertical plane	1/250 of depth of truss or 20 mm whichever running through centre ever is the least of supports.
iii)	Crane Girders & Tracks	a)	Difference in levels of crane rail measured between adjacent columns.	2.0 mm
		b)	Deviation to crane rail gauge	± 3.0 mm
		c)	Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0 mm
		d)	Deviation of crane rail axis from centre line of web.	± 3.5 mm
iv)	Setting of expansion gaps		At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C.	

The coefficient of expansion or contraction





shall be taken as 0.000012 per Deg.C per unit length.

II. For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ± 3.0 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10M section of height and not more than 7.0 mm per 30 M section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.03.00 Acceptance

Structures and members which have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.1.0, 4.1.1, 4.1.2, 4.1.3 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and/or otherwise approved by the Consultant shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this Contract. Acceptance of erected steel structures shall be either after completion of erection of the whole building or in blocks.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 NOT USED

5.01.01 Tentative Programme

The successful bidder shall submit a tentative programme based on the information available in the Tender Document and visit to Site indicating the structure-wise erection schedule proposed to be maintained to complete the job in time in accordance with the Contract.

5.01.02 Constructional Plant and Equipment, Tools, Temporary Works & Manpower(after award of contract)

A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the successful bidder which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.01.03 Erection yard(after award of contract)





A site plan showing the layout and location of the erection yard proposed to be established by the successful bidder shall be furnished indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the successful bidder shall comply with the same without any claim whatsoever.

5.02.00 After award of the Contract

After award of the contract, the successful bidder shall submit the following :-

5.02.01 Detailed Programme

The successful bidder shall submit a detailed erection programme for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.02.02 Fortnightly Progress Report

The successful bidder shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.2.1 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the successful bidder shall also furnish details of fabricated materials in hand at site and the strength of his workers.

6.00.00 MISCELLANEOUS GUIDELINES

SAFE ERECTION PRACTICE

(a) DO'S

- (1) Carry out erection only after structures are thoroughly inspected and cleared.
- (2) Start erection from braced bay.
- (3) Ensure proper packing below the columns to have correct levels (to be checked by survey schemes)
- (4) Ensure proper anchoring of column base by tightening of all anchor bolts.





- (5) Ensure that guying is done at 2/3rd height in 3 directions 120degree apart.
- (6) Ensure that guy ropes are fully tight and anchored. Size of the guy rope should be adequate to take loads
- (7) Provide temporary bracing wherever needed.
- (8) Outstanding of flanges of beams /columns are to be protected against local bending at location of slinging during erection.
- (9) Ensure that cross beam/bracings are erected only after the cleats/gussets are fully welded.
- (10) Do the welding of cross beams with cleats, only after ensuring all bolts are in position and are tightened fully.

(b) DON'TS

- (1) Don't leave the structures without proper guying in all directions till they are braced.
- (2) Don't miss to anchor properly at the base of columns with anchor nuts fully tightened.
- (3) Don't use manila ropes in place of steel ropes for guying.
- (4) Don't support the cross beams with temporary jigs. Ensure all the bolts are provided and tightened.
- (5) Don't use bracings/tie members for fixing lifting tackles/diversion pulleys/cable trays to avoid damages due to erection loads.
- (6) Avoid indiscriminate cutting/notching of erected and loaded structures.
- (7) Don't use column bases for anchoring guy ropes of structures.

GENERAL INSTRUCTION FOR WELDING

The Contractor shall work out welding procedure for the structures at his own responsibility and submit for Owner's/ consultant's information, considering the following factors.

- a) Specification and thickness of steel.
- b) Specification of electrode or/and base wire.
- c) Welding process (manual arc welding, submerged arc welding).





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- d) Type of structures to be welded (thickness of components meeting at a joint).
- e) Pre and post heating requirement.
- f) Preparation of fusion faces.
- g) Sequence of welding.
- h) Weather condition.
- i) Use of jigs and fixtures etc.
- j) Type of non-destructive testing to be carried out.
- k) Inspection procedure to be followed.
- l) Design requirements of the joints.

Welding of any load bearing structure shall be carried out only by the person who has passed welder's qualification as per IS: 7318 (Part-I).

Contractor shall employ competent supervisors, exclusively for welding works, to ensure that the standard of workmanship and quality of materials comply with requirements of this specification.

All metal arc welding shall be carried out as per IS:9595-1996

Submerged arc welding of mild steel and low alloy steel shall be as per IS:4353-1995

Electrode shall conform to as specified elsewhere.

Purchaser may at his own discretion order periodic tests of the Welders and/or of welds produced by them. Such tests shall be at the expense of the Contractor.

Electrodes shall be stored in a dry place. Electrodes whose coatings are damaged due to absorption of moisture or due any other reason shall not be used.

Low Hydrogen electrodes and flux for submerged welding shall be dried at 250°-300° C for one hour in drying even before use.

For suitability of wire flux combination, procedure test shall be carried out as per IS: 15977-2013 if so required.





Welding shall be done by electric arc process. Generally submerged arc, automatic & Semi-automatic welding shall be employed. Only where it is not practicable, manual arc welding may be resorted to. In case of manual arc welding, recommendations of electrode manufacturer are to be strictly followed.

After completing each run of weld, all slag should be thoroughly removed and surface cleaned before starting the next run of weld. The weld metal as deposited (including tack welds if to be incorporated) shall be free from cracks, slag, inclusions, gross porosity, cavities and other deposition faults. The weld metal shall be properly fused with the parent metal without serious undercutting or overlapping at the toes of the weld. The surfaces of the weld shall have a uniform and consistent contour and uniform appearance.

Fillet weld shall have the correct profile with smooth transition into parent metal. Dressing of welds, if specified, shall be done by such method, which does not cause grooving and other surface defects on the weld or on the parent metal.

All butt welds shall start and end with run-on and run-off plates. All such plates shall be carefully trimmed off by gas cutting after welding is over.

Fillet welds shall not be stopped at corners but shall be returned round them.

If butt weld is to be ground flush with the surface of the member as per drawing. Adequate reinforcement shall be built up and then the same shall be chipped off and ground flush. The grinding is to be done in the direction of stress flow till the transverse marks are eliminated.

Welding shall not be done under such weather conditions, which might adversely affect the efficiency of the welding and arc-strikes on parent surfaces of structures shall be strictly avoided.

Manipulators shall be used wherever necessary and shall be designed to facilitate welding and ensure that all welds are easily accessible to the operators.

Stress relieving after welding shall be done if especially called for in the drawing or specification. Ends of structural members and portions of gussets receiving welding at site shall be left unpainted.

CONTROLS IN WELDING

The extent of quality control in respect of welds for structural elements for both statically and dynamically loaded structures shall be as follows and shall be conducted by the contractor at his own cost. Before inspection, the surface of weld metal shall be cleaned of all slag, spatter matter; scales etc. by using wire brush or chisel.





a) Visual Examination

All welds shall be 100% visually inspected to eliminate the following defects like Presence of undercuts, Visually identifiable surface cracks in both welds and base metals, Unfilled craters, Improper weld profile and size, excessive reinforcement in weld, Surface porosity etc.

b) Dye Penetration Test (DPT)

This shall be carried out in accordance with IS: 11732 – 1995, used for steel castings, for all important fillet welds and groove welds for both statically and dynamically loaded structures to check the following like Surface cracks, Surface porosity. Severity Level 3 shall be considered for acceptance.

c) Ultrasonic testing

Ultrasonic test shall be conducted for all groove welds and heat affected zone in dynamically loaded structures and for other important load bearing butt welds in statically loaded structures as desired by purchaser, to detect the following like Cracks, Lack of fusion, Slag inclusions, Gas porosity.

All butt welds shall be tested for 100 % length by Ultrasonic tests and report shall be submitted.

Ultrasonic testing shall be carried out in accordance with American National Standard ANSI/AWS D1.1-96 Chapter -6: Part F.

Before ultrasonic test is carried out, any surface irregularity like undercuts, sharp ridges etc. shall be rectified. Material surface to be used for scanning by probes must allow free movement of probes. For this purpose, surface shall be prepared to make it suitable for carrying out ultrasonic examination.

d) Radiographic Testing (X-ray and Gamma-Ray Examination)

This test shall be conducted to a minimum of 2% of length of welds of each element of each butt joint for welds made by manual or semi- automatic welding and 1 % of length of weld if made by automatic welding machines. The location and extent of weld to be tested by this method shall be decided by purchaser to detect the following defects like gas porosity, slag inclusions, lack of penetration, lack of fusion, cracks.

Radiographic testing shall be conducted in accordance with American National Standard ANSI/AWS D1.1-96 Part E.

Any surface irregularity like undercuts, craters, pits etc. shall be removed before conducting radiographic test. The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the radiographic film shall be width of the welded joint plus 20 mm on either side of the weld.





Before inspection, the surface of weld metal shall be cleaned of all slag, spatter matter; scales etc. by using wire brush or chisel.

ACCEPTABLE LIMITS OF DEFECTS IN WELD

Limits of Acceptability of welding defects shall be as follows.

a) Visual inspection & Dye Penetration Test –

The limits of acceptability of defects detected during visual inspection and Dye Penetration Test shall be in accordance with clauses 6.9 & clause 6.10 of American National Standard ANSI/AWS D1.1-96 or equivalent Indian Standards for statically as well as dynamically loaded structures respectively.

b) Ultrasonic Testing –

The limits of acceptability of defects detected during ultrasonic testing shall be in accordance with clause 6.13.1 & clause 6.13.2 of American National Standard ANSI/AWS D1.1-96 Chapter 6: Part C or equivalent Indian Standards for statically and dynamically loaded structures respectively.

c) Radiographic testing –

The limits of acceptability of defects detected during Radiographic testing shall be in accordance with clauses 6.12.1 & 6.12.2 of American National Standard ANSI/AWS D1.1-96 Chapter 6: Part C or equivalent Indian Standards for statically and dynamically loaded structures respectively.

RECTIFICATION OF DEFECTS IN WELDS

In case of detection of defects in welds, the rectification of the same shall be done as follows.

- a) All craters in the weld and breaks in the weld run shall be thoroughly filled with weld.
- b) Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth transition of weld to parent metal.
- c) Welds with cracks and also welds with incomplete penetration, porosity, slag inclusion etc. exceeding permissible limits shall be rectified by removing the length of weld at the location of such defects plus 10 mm from both ends of defective weld, and shall be re-welded. Defective weld shall be removed by chipping hammer, gouging torch or grinding wheel. Care shall be taken not to damage the adjacent material.





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**GUIDELINE
FOR
ROADS AND DRAINAGE**



Development Consultants Pvt. Ltd.

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**GUIDELINE
FOR
ROADS AND DRAINAGE**

1.00.00 SCOPE

This specification covers all work required for the construction of R.C.C road including box-cutting, edging, Subgrade, sub-bases preparation, RC slab etc. and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work.

This specification also includes all work required for drainage including road side drain, R.C.C. culverts, manholes etc. and all other incidental items.

2.00.00 GENERAL

2.01.00 All the required roads within the battery limit of Chimney Package, shall be under the scope of the bidder including formation of sub-grade, sub-base and laying of RCC. All the required roads in the plant area within the battery limits of Chimney package and connecting the same with the plant main roads will be executed by respective successful bidder. Approach roads to all the buildings, structures, facilities for this Chimney package shall be provided by the successful bidder.

Work to be provided for by the Successful Bidder

The work to be provided for by the Successful Bidder, unless specified otherwise, shall include but not be limited to the followings:

- a) Furnish all labour, supervision, services, tools and plants, transportation etc. required for the work. All materials and equipment shall be supplied by Seller.
- b) Submit for approval detailed schemes of all operations required for executing the work e.g. material handling, placement, services, approaches etc.
- c) To carry out and submit to the Owner/Consultant results of tests whenever required by the Owner /Consultant to assess the quality of work.





2.02.00 Work to be provided for by Others

No work under this specification shall be provided for by any agency other than the Successful Bidder unless specifically mentioned elsewhere in the Contract.

2.03.00 Codes and Standards

All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant I.S. Specifications and Codes of Practice.

1. Specification for road and bridge works of Ministry of shipping & Transport (Roads wing) Published by the IRC.
2. IRC-19 Standard specifications and Code of Practice for Water Bound Macadam.
3. IRC:SP-11 Hand Book of Quality Control for Construction of Roads and Runways.
4. IS:456 Indian Standard Code of Practice for Plain and Reinforced Concrete.
5. IS:2212 Code of Practice for Brickwork.
6. IS:783 Code of Practice for Laying of Concrete Pipes.
7. IRC:15 Code of practice for construction of Concrete Pavement.
8. IRC:58 Guidelines for the Design of plain jointed Rigid Pavement.
9. Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by Indian Standard Specification, any other standard practice as may be specified by the Owner/Consultant shall be followed.

2.04.00 Conformity with Designs

The Successful Bidder shall carryout the work as per the Bidder's drawings which are approved by the Consultant and/or the Consultant's instructions.

2.05.00 Materials to be Used

2.05.01 General





All materials required for the work shall be of best commercial variety and as approved by the Owner/Consultant.

2.06.00 Quality Control

The Successful Bidder shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Owner/Consultant. Permitted tolerances for road works are described hereinafter.

2.07.00 Concrete Road and Rigid Pavement.

Plant Roads:

Access within the plant site shall be provided by a system of roadways. All roads within this Chimney package are RCC roads only including approach roads to the buildings/structures.

All building shall be approached by access road, which shall either be single or double lane road depending upon the functional requirement. Access roads shall also be provided to areas such as transformer areas, steam generator Area and other equipment area shown in the plot plan, where access is necessary for inspection, operation and maintenance.

The sub base over the well compacted subgrade of all plant service roads within the battery limit of Chimney package will initially be made of well graded granular material like locally available crushed stone as per IRC-63 and 100mm DLC with hard shoulder on either side of carriage width. After major construction activities are completed the road shall be surfaced with RC concrete slab as per proper design requirement.

All Roads where there is heavy vehicle movement shall be of RC concrete roads with hard RC shoulder.

All roads within battery limit of Chimney package shall have rectangular RCC side drain along both sides.

All RCC Roads shall be designed in accordance with the provision of the latest edition of the relevant I.R.C. codes of practice and MOST specification (MORT&H) for movement of heavy equipment.

The sub-grade whether in cut or fill shall be well compacted to utilize its full strength. The R.C.C roads of required thickness as per design shall be laid over 100mm DLC on a crushed stone sub-base of 230 mm consolidated thickness with 63 mm downgraded aggregate size.

All the roads inside the plant area shall be of reinforced cement concrete of minimum 250 mm thick.





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The sub-grade whether in cut or fill shall be well compacted to utilize its full strength. The R.C.C roads of required thickness as per design shall be laid over 100mm DLC on a crushed stone base/sub-base of 230 mm consolidated thickness with 63 mm downgraded aggregate size. A separation layer of 125micron thick impermeable Plastic sheeting shall be provided below the RCC slab.

The width of the carriage, shoulder and drains shall match with the existing connecting roads.

All the roads shall be constructed before start of construction activities for buildings and shall again be repaired / made good after completion of construction of activities i.e at the time of handover / project.

All type of roads shall have a minimum turning radius as per relevant IRC codes (IRC-38).

Boulders shall be provided alongside of all type of roads near equipment which requires protection. Spare duct bank shall be provided under all type roads spaced at 100m intervals.

Signs shall be provided for vehicle management and shall meet the indian standards. All signs shall be dual worded in both English and the local indian language. Finished top (crest) of roads shall be as per CEA guide lines. Geometric design of road shall be in accordance with IRC: 73. The ruling gradient for roads in longitudinal direction shall not exceed 1 in 25.

The shoulder shall be laid with slope of 1 in 30.

On either side of roads, open drains shall be provided. Minimum clear width of drains shall be 600mm or the connecting drains whichever is higher..The drains shall be designed and built using RCC. Drainage lines and other underground services shall be located at least 1m clear from the edge of the roads. All service and utility lines crossing the roads shall be taken through NP3 class RCC pipe designed for impact loading. All culverts carrying storm water shall be cast in place RCC box culverts.

No underground service piping except for drainage and sewage system shall run directly below the road (including upto 1 m. from edge of road) along its longitudinal direction.

Surface drainage of roads shall be provided by giving proper longitudinal slopes and cross falls.

The roads must be designed for the heaviest equipment of the plant and before designing the CBR test to be carried out. Road shall be designed as per IRC & MOST standards. (MORT&H).





The Cross section for Concrete road in general shall be as follows:

- i) The Sub-grade, whether in cut or fill shall be well compacted to utilize its full strength. The Sub-grade shall have no soft spots or voids and undulations and shall be well compacted to achieve a minimum 95% dry density.
- ii) crushed stone sub-base of 230 mm consolidated thickness with 63 mm downgraded aggregate size.
- iii) 100mm thick dry lean concrete (DLC).
- iv) A separation membrane shall be used between concrete slab and the sub base. The membrane shall be impermeable plastic sheeting of 125 microns thick laid flat without creases.
- v) Pavement of 250mm thick M35 mix, with double mat reinforcement of 10tor @ 200 c/c both ways or as per the design whichever is higher.
- vi) The drainage system shall be designed for precipitation intensity of 100mm per hour.

The above specified description is minimum and indicative and the successful bidder has to design and provide roads as per actual functional requirements and design criteria stipulated in relevant codes.

The detailed methodology for construction of concrete /rigid pavement including construction and expansion joint shall be prepared by the successful bidder for approval of Owner.

2.08.00 Road Side Drains

2.08.01 Formation of Drains

Open RCC rectangular drains shall be provided for storm water. The thickness of sides & bottom shall be minimum 125 mm or as per design considerations whichever is higher. RCC box culverts shall be provided for road and rail crossing. Drains shall be provided on both sides of the roads.

Inside surface of the drain shall have screed concrete with 12mm blue metalchips in M20 and smooth neat cement finish over screed concrete. Invert of the drain shall be decided in such a way that the water can easily be discharged to the recommended nearest outfall outside the plant boundary. The slope of the drain shall be 1:1000 longitudinally in general. However, discharge velocity shall be within non-silting & non-scouring condition.

2.09.00 Culverts

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the instructions of Owner/Consultant after clearing the





site, etc. as per specifications of earthwork. Backfilling with ramming and watering shall be done after construction of the foundations.

The construction of culverts shall be done true to lines and levels and as shown on the drawing. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed, as applicable. The top level of the Culverts shall match with the top level of road.

2.10.00 Shoulders

The sub grade shall be compacted well and the sub base shall be 230mm consolidated thickness of stone boulders/ soling as per specification over which P.C.C (M20) shall be laid to required thickness. The level of the shoulder shall be in line with the road top level or at higher level based on the location which will be decided during detailed engineering. Necessary chutes if required to the adjoining drain shall be provided.

2.11.00 Kerbs

P.C.C (M20) Kerb for full depth of the pavement shall be provided on both sides of carriage way of concrete roads. Kerbs shall be laid and set in place before completing the concrete wearing surface as well as the concrete wearing surface of shoulder. Setting shall be done in mortar where so specified They shall be laid and set in such a way as to obtain straight lines in the finished work, the top surface matching with the finished surface of shoulder if the shoulder is at higher level of the road. Where the road edge forms a curve, the kerbs shall follow such curve. Gaps may be left as shown in drawings or as may be required to provide for drainage. They shall be fixed true to line and level and secured in position by approved means.

The Kerbs shall be painted as per IRC- 35 (latest edition).

3.00.00 EXECUTION

3.01.00 NOT USED

3.02.00 NOT USED

3.01.03 Relation with Water Supply Pipeline

Unless specifically cleared by the Owner/Consultant, under no circumstances shall drainage pipes be allowed to come close to water supply pipelines.

3.02.00 Manholes and Inspection Chambers

The maximum distance between manholes shall be 30 meter unless specifically permitted otherwise. In addition at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not





exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water-tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connection to existing pipelines shall be through a manhole.

Manholes shall be provided with standard covers, usually C.I. or as directed by the Consultant. The covers shall be close fitting so as to prevent gases from coming out.

3.03.00 NOT USED

3.04.00 NOT USED

3.05.00 Cement Concrete (Plain and Reinforced)

Shall be as laid down in "Guideline for Cement Concrete (Plain and Reinforced)" Vol: II-B- Section: I - Part – A Sub Section - IV.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Roads

All testing, as mentioned in the body of the specification and as mentioned in Clause No. 900 of Specification for Roads and Bridge Works, 1983 published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Successful Bidder as per direction of the Consultant. No extra payment shall be made for such tests.

4.02.00 NOT USED

4.03.00 Cement Concrete

The strength requirements and acceptance criteria shall conform to the relevant clauses of IS:456.





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**GUIDELINE
FOR
PROPERTIES, STORAGE AND HANDLING OF
COMMON BUILDING MATERIALS**



Development Consultants Pvt. Ltd.

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**GUIDELINE
FOR
PROPERTIES, STORAGE AND HANDLING OF
COMMON BUILDING MATERIALS**

1.00.00 **SCOPE**

The scope of this Section is to specify the properties, storage and handling of common building materials unless otherwise mentioned in drawings or schedule of items.

2.00.00 **MATERIALS**

a) **Bricks**

- i) Common Burnt Clay Bricks : Bricks for general masonry work shall conform to IS: 1077-1970 and for face brick work shall conform to the specifications in IS: 2691-1972.

Bricks for general masonry work shall be of first class (Class-A) quality, well burnt, of uniform size, shape and colour free from cracks, flaws warpage or nodules or free lime, having a frog 100mm in length 40 mm in width and 10mm to 20mm deep on one of its flat sides and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps boles etc.

Compressive strength shall be as per table-1 below. The bricks, when tested, shall have a minimum average compressive strength for various classes as given in Table-1 below. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any brick tested exceeds the upper limit for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified in Table-1 for the purpose of calculating the average compressive strength.





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The average value of water absorption of bricks when tested shall not be more than 20% by weight.

All bricks shall have rectangular faces and sharp straight edges. Maximum permissible chippage for face bricks shall be 6 mm at the edges and 10 mm for corners. The rating of efflorescence shall not be more than 'moderate'.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved sample shall be retained by the Engineer for future comparison and reference. The colour and texture of face bricks shall be up to the specification and defective bricks shall be removed immediately from site at the Bidder's own cost.

TABLE-1

Class Designation	Average compressive strength		
	Not less than		
	N/mm ²	(kg/cm ²)	
12.5(125)	12.5	(125)	
10 (100)	10	(100)	
7.5 (75)	7.5	(75)	
5 (50)	5	(50)	
3.5 (35)	3.5	(35)	

- ii) Fly Ash Lime Bricks (FLAG Bricks): The Fly Ash Lime Bricks (flag Bricks) shall conform to IS 12894. The dimensions of the Fly ash bricks shall be 190x90x90mm. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with frog on one flat side and without frog on other flat side. Fly ash shall conform to IS 3812. The average compressive strength shall conform to class 5 as given in the table above.

Note : Fly ash bricks will be operated only for non-load bearing walls and above ground level.

Sand : Deleterious materials, such as clay and silt in the sand shall preferably be less than 5%.

Lime : Lime shall conform to class 'C' hydrated lime of IS 712

Additives : Any suitable additive considered not detrimental to the durability of bricks may be used.





Alternatively Lime may be replaced by Cement in manufacturing of Fly ash bricks. The cement shall be blended at the rate of 8 to 12%.

- iii) **Mechanised Autoclave Fly Ash Lime Brick:** These bricks shall be machine moulded and prepared in plat by appropriate proportion of fly ash and lime/cement. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and the frog shall be of 100/80 mm in length, 40 mm width and 10 to 20 mm deep on one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

b) **Stone**

For all concrete works Blue Granite Metal shall only be used.

All stones shall be from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean and sharp and shall show uniformity of texture, without loose grains and free from any dull, chalky or earthy appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours immersion and for laterite this percentage is 12%. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Bidder and approved samples shall be retained by the Engineer for comparison of bulk supply. The compressive strength of common types of stones shall be as per Table below.

TABLE-2

Type of stone	Maximum Water Absorption Percentage by weight	Minimum Compressive Strength kg/sq.cm
Granite	0.5	1000
Basalt	0.5	400
Lime stone(Slab & Tiles)	0.15	200
Sand stone (Slab & Tiles)	2.5	300
Marble	0.40	500
Quartzite	0.40	800





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Laterite(Block)	12	35
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c) **Lime**

Lime shall be stone lime and conform to the specification Building Limes - IS: 712. Lime putty may be prepared from hydrant lime or quick lime. Hydrated lime shall be mixed with water to form putty and stored with reasonable care to prevent evaporation for at least 24 hours before use. Quick lime shall be shaken with enough water to make a cream, passed through a No. 0 Sieve and then stored with reasonable care to prevent evaporation for at least 7 days before use.

d) **Cement**

Cement used shall be ordinarily Portland cement conforming to Code for ordinary cement in IS: 269 and shall be fresh when delivered. The Bidder shall submit the manufacturer's test certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Bidder is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Bidder. The Bidder shall also have no claim for this type of suspension of work.

e) **Coarse Aggregates**

Coarse aggregates shall be as per IS:383 latest edition, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS:383 and shall be such as to produce a dense concrete of the specified proportions and strength and of consistency that will work readily into position without segregation.

f) **Sand**

Sand shall be hard, durables, clean and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand





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shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosions to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded. Unless otherwise directed by the Engineer all sand shall pass through IS Sieve No. 240 and 15 to 35% of and for masonry mortar and 5 to 50% of sand for plaster shall pass through IS Sieve No. 30. Sand for concrete shall conform to IS: 383.

Generally River sand shall be used for all the works. In case of scarcity/non-availability of River sand, M-Sand may be used at the discretion of the Engineer-in-charge at site.

g) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discolouration, efflorescence etc.

h) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings which may impair proper bond. Structural steel shall conform to IS: 226. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432 Cold twisted steel bars shall conform to IS: 1786. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanised. All reinforcements shall be Corrosion Resistant Steel(CRS).

3.00.00 STORAGE AND HANDLING OF MATERIALS

a) Bricks

Bricks shall not be dumped at site. They shall be stacked in regular tiers, even as they are unloaded, to minimise breakage and defacement of bricks. Bricks selected for different situation of use in the work shall be stacked separately.

b) Stones

Stones shall be stored at site in manner approved by the Engineer. Dressed stone for wall facing, paving etc. shall be stored with special care to avoid defacement of faces and edges or damp and rust stains.





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c) **Lime**

Lime shall be stored in weatherproof sheds.

d) **Cement**

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Bidder and shall be removed from the site immediately.

e) **Coarse and Fine Aggregates**

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other injurious substances at any stage. Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

f) **Reinforcement**

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.





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VOLUME: II-B

SECTION: I

PART: B

SUB SECTION: I

**GENERAL SPECIFICATION AND DESIGN CRITERIA OF
CHIMNEY – CIVIL & STRUCTURAL WORKS**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part B; Sub Section: I
General Specification & Design Criteria
of Chimney – Civil & Structural Works



**Tender Specification
for
Chimney**

**NLC TamilNadu Power Ltd.
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**GENERAL SPECIFICATION AND DESIGN CRITERIA OF CHIMNEY -
(CIVIL & STRUCTURAL WORKS)**

1.00.00 GENERAL

1.01.0 SCOPE OF WORK

The Works as detailed hereinafter pertaining to RCC Bi-Flue Chimney for the presently operating thermal power plant having two units of 500 MW capacity each, in Tuticorin, Tamil Nadu for NLC Tamil Nadu Power Limited (NTPL). Since new FGD plant is being envisaged, the new Chimney construction is required.

- All Civil and structural works for RCC Bi-flue Chimney 150M high with internally lined (borosilicate) steel flues enclosed by RCC Wind Shield to suit MOEF norms with Rack & Pinion Elevator.
- Other Auxiliaries, Internal Steel Platforms, External RCC Platforms, ladders, Rack & Pinion elevator etc.
- Structural steel staircase upto the top most internal platform and from there cage ladder to roof of the chimney
- Duct supporting arrangements within the battery limits as per functional requirements
- Electrical-cum-C&I building / Analyzer shelter to accommodate extractive type analyzer Panels, Data loggers / PC, DB and other necessary accessories. This will be a RCC framed-structured single-storey building (of adequate size to meet the electrical and C&I functional / layout requirements as per technological requirement) with RCC roof. This building shall be provided to satisfy all functional and operational requirements of Electrical / C&I systems as specified elsewhere.
- RCC Approach Roads / Paving (as required) along with Street Lighting.
- Service Drains as necessary.

The Reinforced Concrete Bi-flue Stack of 150M high shall comprise of two nos. internally lined (with Borosilicate) steel flues enclosed by a wind shield of reinforced concrete shell to suit MOEF norms with R&P Elevator.





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The steel flues shall be vertically supported at top & at intermediate levels (minimum four platforms) and horizontally restrained on steel platform at intervals satisfying all functional requirements. The steel platforms shall be supported on reinforced concrete shell wind shield. The suspended position of the steel flues shall be connected to the bottom supported position of the flues by expansion compensator so as to compensate for the large thermal movements of steel flue.

The scope of this work shall consist of, but not limited to, the design and construction of reinforced concrete windshield, foundations, Borosilicate lining, associated pipe works, stairs, cage ladders, rack & pinion type elevator, external and internal platforms, walkways as specified or required for operation and maintenance, access doors, MS handrails, steel fittings, fixtures, inserts including fabrication, galvanizing (wherever required) and erection of associated steel work and other chemicals on the completed structures etc. all complete as per functional requirements and as per directions of Owner.

The scope of work under this specification shall include providing engineering design and drawings, all labour, supervision, materials, shuttering and scaffolding including slip form, construction equipments including cranes, hoists, batching plants etc. tools and plant, supply and transportation of all incidental items not shown or specified but reasonably implied for successful completion of the work. The nature of the work shall generally involve foundation, excavation, dewatering, shoring and strutting, backfilling around underground structures and plinth filling, sand filling, disposal of surplus soil outside plant boundary and as directed by the Engineer in charge, concreting of grade as specified, formwork including automatic climb form, fabrication, galvanizing (wherever required) and erection of steel structures and inserts, finishing anchor bolts etc. as required.

The successful bidder shall furnish the Slip form design including all detailing and analysis for Owner / Consultant for approval before taking up the shell work at site.

The scope shall include design, engineering, construction of RCC Chimney including all manufacture, assembly / pre-assembly, tests at manufacturer's works, shop painting, seaworthy packing, complete with all accessories, auxiliaries as specified hereinafter and as required for safe and trouble free continuous commercial operation.

The scope of this specification also includes but not limited to erection / installation, supervision, including unloading, storage and handling at site, site testing, commissioning, and other erection services to ensure trouble free operation and commissioning of the plant as per mechanical requirement.

The Successful bidder shall carryout, at his own cost, model test of chimney in wind tunnel in an approved laboratory to investigate the aerodynamic behavior of the chimney. Effect of adjoining structures such as boilers, cooling tower etc. on magnifying wind loading on the chimney shall be studied in a wind tunnel before the designs are finalized. A provision of 10% increase in the wind load





forces (due to dynamic interference effect) as calculated based on relevant codes, shall be considered in the initial designs. Worst of the forces calculated as per as per codal requirements and forces obtained from wind tunnel study shall be considered as design forces for final design of shell and foundation. Wind tunnel study has to be done in any one of the following approved labs – SERC-Chennai, IISc-Bangalore and IIT-Kanpur and the study report shall be got approved by the owner / Consultant. The model test shall be duly witnessed by the owner and the Consultant.

The flue ducts shall be entering as per layout given by FGD Package vendor.

Refer to Vol-II-B Sec-I - Part B - Sub Section-II of this specification for Guideline for Construction of RCC Bi-Flue Chimney.

The area around Chimney for 5m width shall be RCC paved except for the portions if already paved. Wherever existing paving is dismantled during construction activities shall be restored with RCC paving at the possible locations.

1.02.00 General parameters of the chimney

Total height of the chimney above FFL	:	150 m.
RCC Wind shield (shell) enclosing Two steel flues, one for each Boiler.		
No. of Boilers.	:	Two
Particulate emission	:	30 mg/Nm ³ (approx)
Volume of Gas (at NTP 0 ° C and 1.013 bar)	:	734.791 Nm ³ /sec * (per flue)
Temperature of flue gases.	:	60° C *
Acid dew point	:	75° C *
Flue gas pressure at Chimney entry level.	:	10 mm WC * (To be considered as NIL for stack sizing)
Stack Exit velocity	:	Maximum 18.3 m/s (With Borosilicate block lining as per latest EPRI guidelines)
Note: The parameters marked with asterisks (*) are indicative only.		
Inlet-duct Center line elevation.	:	During Detail
Duct opening Dimensions.	:	Engg. Stage
Minimum top internal shell diameter.	:	To be decided by Bidder
Minimum bottom internal shell diameter	:	To be decided by





Bidder

** The bidder shall use the borelog data of Owner's Existing Soil Investigation Report for reference purpose. Moreover, bidder is at liberty to carryout suitable number of borehole tests at site to assess the pile capacity values for pile foundations and the Net Safe Bearing Capacity values for open foundations prior to quote. After contract award, the design of foundations shall be carried out as per the provisions of IS-456 & IS-2911. The design, type, size, depth of the foundation shall be based on the approved soil investigation report of the successful Bidder/Owner's soil investigation report whichever is conservative.

1.03.00 The windshield shall be of RCC construction. Two nos. of steel flues shall be housed within the windshield. Flues shall be supported on the top of platforms. Platforms shall be provided at regular interval. The flue ducts shall be entering as per layout given by FGD Package vendor.

1.04.00 All internal platforms shall be supported on R.C. shell of the wind shield. Internal structural steel staircase for access to all platforms shall be provided. Rolling shutter (electrically operated) and one Steel Door at grade floor level shall be provided for access into the windshield and on to the platforms. All doors like inspection/ maintenance doors shall be as per IS code / environment regulation.

1.05.00 Natural Ventilation within the windshield shall be provided as required.

1.06.00 **Process Criteria for Wet Chimney**

i) Treated flue gas from the absorber shall be discharged through the chimney flues. The wet flues of chimney shall be suitably lined. The flue duct shall be lined with 51 mm thick Borosilicate glass blocks . External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium sheet. The design & construction of steel chimney liners shall be based on the guidelines of EPRI Revised Wet Stack Design guide.

For bypass condition, existing 275m high Chimney will be utilized.

ii) Wet Chimney Condensate Collection System

To avoid the carryover of the condensate/acidic dews/water droplets/ gypsum coming out of the wet chimney a condensate collection system shall be provided. Design of the condensate system should be such that the liquid condensate film near the exit of the stack is collected in the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the nearby area.

iii) Wet stack flow model study





A wet stack flow model study shall be performed by the Contractor or by the Sub-Contractor (who satisfy the requirements as specified in Vol II A. Section III Annexure-1 Acceptance criteria for Sub-contractors) for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed for this project. A wet stack model study shall consist of the following:

- a) Condensation calculations.
 - b) Minimum 1:12 scale physical flow model for liquid collector design.
 - c) Computational flow model for plume downwash analysis.
 - d) Physical or computational flow model for CEMS elevation flow performance.
- iv) Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), including the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to drain out to the ground before evaporation.
- For the model studies, sharing of the necessary input and result details with the FGD vendor shall be considered for reiteration of model study and finalizing the ducting and flue can design.
- v) A common Nickel based alloy material storage/neutralizing tank for both the units of storage capacity of as per mechanical requirement of condensate from both the flues shall be provided complete with neutralizing chemicals dosing, mixing and preparation system. The neutralized condensate shall be pumped to common drain system by pumps as per mechanical requirement, complete with valves, piping and fittings, level control and monitoring etc. All the equipment, piping and fittings in contact with the condensate shall be of suitable material for the operating duty. The condensate collection system in this package includes condensate from FGD outlet up to flue can top.
- vi) All chimney condensate collection equipment shall be easily accessible for O&M. The design of the stack condensate collection system including that are covered under model study shall be provided by successful bidder. The Laboratory where the condensate collection



study is to be conducted is to be approved by the Owner/Consultant and report shall also be submitted for approval by Owner/Consultant.

vii) Chimney Liner Materials

All materials shall conform to IS Codes. However, the following shall apply: The flue duct shall be lined internally with Borosilicate glass blocks of 51mm thick. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium sheet over insulation.

The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. The Insulation shall consist of 6 layers of insulation material (resin bonded rock wool) each of a minimum thickness of 25 mm and all joints shall be staggered. The material shall have a minimum density of 200 kg/cum. Blanket type insulation shall not be used. This shall be protected from the elements by wrapping with 2mm thick Titanium/C-276 sheet cladding. Testing of insulation material to satisfy the specific requirements and properties as outlined in this specification IS: 8183 and in the relevant drawings by the contractor shall be carried out.

The thickness of Borosilicate shall be 51mm. The lining material should withstand minimum 200°C for continuous operation of maximum 30minutes duration.

1.07.00

SPECIFICATION FOR BOROSILICATE LINING

Borosilicate Glass Block Internal lining material, for the flues for the entire height including the lining of flue gas duct up to chimney inlet flange (including transition duct)..

- i) Borosilicate Cellular Glass Block, 51 mm thick, as required
- ii) Epoxy Primer
- iii) Adhesive membrane
- iv) Stack condensate collection system to avoid the carryover of the condensate/acidic dews/water droplets coming out of the stack.

Borosilicate Blocks:

The lining system shall use closed cell borosilicate glass blocks with the following physical properties:

- i) A coefficient of linear thermal expansion not greater than $5.5 \times 10^{-6}/^{\circ}\text{C}$, as per ASTM E228
- ii) Compressive strength of at least 1.38 Mpa / 1.1 N/Sq.mm as per ASTM C.165
- iii) Flexural strength of at least 0.62 Mpa / 0.8N/Sq.mm as per ASTM C.203/C.240





- iv) Thermal conductivity of 0.087 W/m²K at a mean temperature of 38 °C as per ASTM C177 and ASTM C518

Adhesive membrane

The adhesive membrane shall be a 2-component urethane asphalt mastic having excellent elastomeric properties and be acid & heat resistant. The adhesive membrane shall be applied in between and behind the blocks in a 3.2mm thick layer ensuring a proper bond and adhesion. The adhesive membrane shall have the following properties.

- i) Tensile strength at 23° C of 1.0 N/mm² as per ASTM D.412
- ii) Elongation at 23° C of 147.0 % as per ASTM D.412
- iii) Moisture vapor transmission of 0.0048 Perm inches as per ASTM C.96 Method E
- iv) The adhesive shall show no slump after 5 hours conditioned at 60°C with a film thickness of 3/32" as per ASTM 6511, standard test methods for solvent bearing bituminous compounds, section 12 behavior at 60°C.

Specification of primer

Primer to be applied on steel substrate receiving borosilicate glass block lining system shall have the following properties including thickness, physical & chemical properties.

- i) The primer shall be a high performance epoxy primer. the primer shall be applied in 1 layer with a WFT of 3 to 5 mils
- ii) The primer shall be applied either by rolling or spray gun Welds and joints shall receive an additional layer of primer by brush prior to rolling or spraying
- iii) The solids by volume of the high performance epoxy primer shall be no less than 50%
- iv) The bonding of the primer to the steel shall be at least 1400 psi. as per ASTM D4541

Specification for surface preparation for steel substrate.

- The steel surface shall be grit blasted to a cleanliness of SA 2 1/2 and approved by the supplier of the lining system
- The substrate shall thereafter be primed using a high performance epoxy primer within a short time window approved by the supplier

Wet stack properties of the lining system

The lining system (borosilicate glass block and adhesive) shall be tested for its wet stack surface properties by an independent approved institute, subject to acceptance by the Purchaser, and has during such testing been shown to allow, without any significant re-entrainment of flue gas condensate, a flue gas velocity of 18.3 m/s.

Bidder shall provide a project specific "Wet Stack" study, performed by an independent approved institute, subject to acceptance by the Purchaser,





indicating the correct placement and design of liquid collection gutters and liquid drains to ensure minimization of liquids and condensates entering the chimney.

Installation of Borosilicate block lining system

Surface Preparation & Surface Cleaning

Lining of the chimney shall include necessary cleaning, surface preparation and all arrangements for man material shifting, approach facilities, inspection etc.

Mixing of Adhesive Membrane

- The Adhesive membrane shall be mixed according to the direction for the product use in the correct mixing ratio.
- The temperature for mixing the main material and hardener shall be about 24 deg C.
- Appropriate mixing method shall be used for equal mixing and should be blended for the required appropriate time.
- Sufficient time shall be allowed for curing

Mixing machine

- Mixing machine shall be used for preparing the 2 component Adhesive Membrane on site.
- In order to ensure consistent, high quality mixing of the components of the lining system adhesive, (an) automated mixing machine(s) should be provided using a 3,200W mixer motor, with fail-safe protection against the operator error of mixing the main adhesive component without its hardener.
- The mixing machine must be CE – approved.
- The mixing machine shall have thermal motor protection to minimize failure and fire risk.
- Adequate number of mixing machines shall be employed for completion of the installation works for the two units/flue cans within the scheduled time.

Mixing of Epoxy Primer

- Epoxy Primer shall be mixed according to the direction for the product use
- Mixing ratio shall be as recommended by OEM
- Epoxy Primer shall be blended by using Mechanical Mixer for the required minimum time.

Installation of Borosilicate Block

- The Adhesive membrane shall be applied as per the instructions of OEM.
- Arrange the borosilicate glass blocks such that there is no blank space between the block and surface. The adhesive should fill the side joint and flow out to the edge. The block shall completely stick to adhesive applied on the surface.
- Block whose edge is broken shall not be used.
- All the equipments and tools required to install Borosilicate Glass Block lining system including Polyethylene film, Rag, Wire brush, Plastic sink, Electric drill, Jiffy Mixer Blade, Insulated saw, Float, Paint brush, hand cleaner,





Cleansing glove, Hygrometer, Surface thermometer, white chalk, white spray etc as required shall be arranged by the bidder.

- It is important that the liner substrate be fully covered with the adhesive material to ensure that a continuous chemical- and moisture-resistant barrier is formed between the inside and outside of the flue. A nominal adhesive thickness of 3.2 mm is recommended behind and between each block. A 1.6-mm thick layer should be troweled onto the liner, as well as to the sides and back of each brick, before installation. This double-buttering technique ensures a full bond of each block to the liner and to each other. Excess adhesive material squeezed out during placement of the block should be struck clean.

Ensure the proper radial alignment of the blocks and to strike the adhesive/mastic flush with the inside surface of the liner. The surface of the block should be clean and free from smeared adhesive/mastic material. If the maximum projection or offset between bricks on the interior surface of the liner shall not exceed (3.1 mm).

Inspection

- Inspection and testing including adhesion shall be as per approved QAP.
- The mixing, curing and adhesion characteristics of the adhesive membrane shall be evaluated by applying it onto a test area of the same material and surface preparation of the substrate. Work life and initial set time may be visually observed. Cure shall be uniform.
- The installation procedure of the lining system shall be verified by installing the system on a transparent panel. Visual inspection shall be made of back, end and side joints.

Testing

- Borosilicate Lining Block should withstand Hydrolytic resistance as per ISO 719.
- The lining system manufacturer shall demonstrate a proven quality control system that monitors and documents the key physical properties mentioned in the specification.
- Bidder shall check and provide satisfactory proof to owner, that the back joint adhesive of the borosilicate lining system will not exceed its supplier recommended operating temperature during any operating condition that can occur before and after FGD system commissioning.
- The Borosilicate Block shall withstand EPRI parameters of 18.3 m/s flue gas velocity

Heat cycling resistance

- The lining system shall, through documented testing, have been proven resistant to thermal shock, for a minimum of 1000 cycles, where each cycle results in the lining surface temperature to rise from ambient temperature to 180 °C, and back to ambient temperature.
- The lining system shall also withstand occasional excursion of flue gas temperature of more than 200°C.

On site supervision and QA/QC services

- The lining system (borosilicate glass block and adhesive) supplier shall provide on-site technical support and QA/QC supervision, and shall employ





QA/QC supervisors with a demonstrated experience of at least 5 years in technical support and QA/QC supervision of the subject lining system.

Performance, safety and fire risk

- The lining system (borosilicate glass block and adhesive) shall be tested and certified for fire risk by an approved institute subject to acceptance by the Purchaser, and thorough testing as per relevant ASTM standards.

Requirement in Flues

Sample Point

- Borosilicate block primer and high nickel steel bar will be applied to sample points to make it acid resistant.
- The nozzle (Pipe tube) shall be of suitable alloy steel to withstand design operating environment.
- Nozzle shall be fully seal-welded both inside and outside of the steel duct plate. The inside weld shall be ground smooth.
- The nozzle shall be flanged and not threaded.
- The Glass Blocks shall be Cut and shaped as required to fit. The block shall be fully bonded to the exterior surface of the nozzle with adhesive membrane.

Manhole and Access doors

- Manholes/Access doors shall be modified by application of borosilicate blocks.
- High nickel alloy stop bars of 2mm thickness for protection from acidic condensate.
- Fibre gaskets shall be used for sealing.

Collection gutter

- The condensate generated in flue gas while FGD is under operation, shall be collected and discharged from bottom of the flues.
- The material of gutter including drain and base plates shall be made of suitable alloy steel to withstand design operating environment.
- All welds shall be full seal welds.
- The surfaces of the alloy materials which will be in contact with the lining system shall be blasted and primed with Epoxy Primer.
- The Glass Blocks shall be fully bonded to the alloy steel.

Puddle Flange

- Puddle flange located at the bottom of soot hopper shall be lined with High nickel alloy material for protection from acidic ash.

Expansion Joints (if any)

- Expansion joints cannot withstand the acidic flue gas during FGD operation and hence shall be provided with acid resistant elastomeric fabric bellows.

Documentation





- a) Documentation shall, as a minimum, comprise the following.
 - i) All drawings including shop drawings for the above works and supply
 - ii) O&M Manual, Installation & Instruction Manual
 - iii) Submission of comprehensive QA documentation after the completion of the lining process in the flue can.
- b) All relevant drawings/documents/data including supply of equipments, not specifically mentioned above but deemed essential for successful completion of the lining work will also be furnished/ supplied by the successful Bidder for approval.
- c) All other miscellaneous equipment and accessories required for a complete functional system which meets the intent and requirements of this specification shall also be furnished by the bidder.
- d) Condensate / acidic dews / water droplets coming out of the stack.

2.00.00 CODES AND STANDARDS

Following is a general listing of Codes and Standards to be used in the design. The latest editions/ revision (as on the original Scheduled Date of Tender Opening) of following codes and standards along with addendums/ amendments, if any, shall be followed:

- a) IS: 456 - Code of practice for plain and Reinforced Concrete.
- b) IS: 800 - Use of Structural steel in general Building Construction.
- c) IS: 875 (Part-3) - Code of Practice for Wind Loads.
- d) IS: 1786 - Cold twisted steel bars for Concrete Reinforcement.
- e) IS : 432 - Mild steel and Medium steel Bars
- f) IS: 1893 (Part 1) - Criteria for Earthquake Resistant Design of Structures: Part 1- General Provisions and Buildings.
- g) IS: 1893 (Part 4) - Criteria for Earthquake Resistant Design of Structures: Part 4- Industrial Structures Including Stack-Like Structures.
- h) IS: 4998 - Design of Reinforced Concrete Chimneys - Criteria
- i) IS: 6533 (Part 1 & - Design Construction of Steel Chimney –





- Part 2) Code of Practice
- IS : 14593 Design and Construction of Bored Cast-In-Situ Piles Founded On Rocks
- j) Reference may also be made to ACI: 307 "Specification for design and construction of R.C. Chimney", If some items are not covered in Indian Codes.
- i) ASCE-1975 : Design and construction of steel chimney liners prepared by Task committee on steel chimney liners, Fossil Power Committee

Books:

- a) Tall Chimney - Design and Construction By S.N. Manohar
b) Reinforced concrete chimney tower By G.M. Pinfold

3.00.00 GRADES OF CONCRETE AND STEEL

The grade of concrete for RCC shall be M-35 for all RCC structures with minimum cement content of 400 Kg/m³.

Ordinary Portland cement namely Grade 43 conforming to IS: 8112 (Latest Revision) shall be used for construction of all RCC structures and foundations as recommended by Owner. However the Ordinary Portland cement (Grade 53) may be used with approval by the Owner. Only one grade of concrete shall be used throughout the height of the shell.

Grade of cement shall be OPC and for underground structures, it shall be minimum 5% -8% C3A content.

High yield strength deformed bars of grade Fe500 CRS conforming to IS 1786 shall be used as reinforcement. Grades /Fe500D CRS/Fe550D CRS may also be used but the design is restricted to Fe500 only.

Structural Steel sections and plates having yield stress 250 MPa conforming to IS: 2062 shall be used. Plates for steel flue shall be CORTEN-B Steel conforming to IS 2062 having yield stress 250 MPa.

4.00.00 DESIGN CRITERIA

Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in IS, reference shall be made to ACI, BS, CICIND and other international standards.





4.01.00 **Loading**

4.01.01 **Dead Load**

All permanent loads due to the weight of chimney shell, internal steel platforms, external RCC platforms, linings, ladders, flue ducts, staircases, Elevator and other accessories etc.

4.01.02 **Imposed Loads**

- i) Imposed load on service platform around Chimney shell, shall be taken as 500 Kg/m^2 . Design live load during construction / erection shall be considered as 1000 Kg/m^2 .
- ii) Imposed loads from duct joining the Chimney shall be considered.

4.01.03 **Wind Load**

The wind loading shall conform to Latest version of IS 875 (Part-3). Following parameters shall be considered for assessing wind loads:

Basic wind speed = 39 m/s at 10m above mean retarding surface.

$k_1 = 1.06$ as per Table 1 of IS 875 (Part-3) (Latest) corresponding to 100 years return period

$k_3 = 1.0$

$k_2 =$ As per IS 4998 (Latest).

$k_4 =$ As per IS 4998 (Latest) and IS 875 (Part 3) (Latest).

Aerodynamic Interference Effect (proximity effect) due to presence of other tall structures and stacks in the vicinity shall be assessed based on wind tunnel test to be carried out by approved specialized agency and shall be incorporated in design.

Profile (diameter, thickness etc.) as well as wind forces (moment/shear etc.) at different sections/levels of chimney shall be calculated as per structural analysis conforming to requirements of IS: 4998 (Latest) and Contract Specification. Wind Tunnel study shall be carried out based on the profile of the chimney determined. Worst of the forces calculated as per codal requirements and forces obtained from wind tunnel study shall be considered as design forces for final design of shell and foundation. Wind Tunnel Study shall be conducted in any one of the following approved Lab/Institute - SERC-Chennai, IISC-Bangalore & IIT-Kanpur and the study report shall be got approved by the Purchaser / Consultant. The model test shall be duly witnessed by the Purchaser and the Consultant and get approved by Owner/Consultant.

4.01.04 **Seismic / Earthquake Load**

Calculation of earthquake forces acting on the Chimney and analysis for the same shall be carried out as per IS: 1893 (Part 4) (Latest) [Zone – II] using the





Response Spectrum Method. Material damping factor and number of modes to be considered for the analysis shall be as per recommendation in the code referred above. However in any case the number of modes shall not be less than five.

4.01.05 Thermal Effect

Thermal effect due to established thermal gradient shall be duly considered as per provisions in relevant IS code.

The temperature gradient ΔT across the shell thickness of wind shield shall be calculated as per IS: 4998 (Latest) but subject to a minimum of 30°C. The temperature stresses shall be calculated according to the procedures given in ACI – 307 and IS: 4998 (Latest).

4.01.06 Local Loads

The effect of following local loads shall be considered.

- a) Local moment produced by corbels (if any).
- b) Local moment due to platforms.
- c) Local moment due to occurrence of ovaling oscillation.
- d) Local moment produced by thermal gradient.

4.01.07 Load Combination

Various load combination for calculation of stresses shall be as under.

- I Dead load \pm Wind load.
- II Dead load \pm Earthquake effect.
- III Dead load \pm Temperature effect.
- IV Dead load \pm Wind load \pm Temperature effect.
- V Dead load \pm Earthquake force \pm Temperature effect.
- VI Circumferential stresses due to temperature effect.
- VII Circumferential tensile stresses due to wind induced ring moment.
- VIII Circumferential compressive stress due to wind induced ring moment combined with temperature.

In Load combinations (I) to (VIII) above, dead load considered shall be with or without the weight of flue, whichever condition is more critical shall be adopted for design. Across wind loads shall be combined with co-existing along wind loads. The combined design moment at any section shall be taken as SRSS of the moments due to across wind loads and co-existing along winds loads.





Limit State Method of Design shall be followed as per Latest IS 4998.

5.00.00 ANALYSIS

5.01.00 Free Vibration Characteristics of Wind Shield

Assessment of Natural Frequencies and mode shapes shall be carried out. For this purpose the Chimney shell shall be idealized as a vertical cantilever with Lumped masses at different nodes. The nodes shall also be provided at each platform level.

The number of modes to be considered in the analysis shall be such that at least 90% of the modal mass is excited.

5.02.00 Wind Loads

5.02.01 Along Wind Load

Along wind load shall be assessed based on methods specified in latest version of IS 4998. Dynamic modulus of Elasticity of concrete as recommended in latest version of IS 4998 shall be used for evaluating the natural frequencies.

Mean drag coefficient 'CD' shall be taken and considered for the concrete shell as per IS 4998 (Latest).

5.02.02 Across Wind Loads

The across wind response due to vortex shedding of the Chimney shall be evaluated as per the method given in IS 4998 (Latest).

5.02.03 Ring Moments due to Wind

The circumferential ring moment due to wind shall be calculated in accordance with of IS 4998 (Latest).

5.03.00 Seismic Analysis

The Seismic Analysis shall be carried out as per IS 4998 (Latest) using the Response Spectrum Method according to IS 1893 (Part-4) (Latest) taking the first 5 modes (minimum) of vibration into account. 5% damping shall be considered for the analysis.

5.04.00 Chimney shall be designed without considering provision of strakes.

6.00.00 COMPONENT DESIGN CRITERIA

6.01.00 Wind Shield and Foundation





The design conditions for the concrete shell shall be as follows:

- 1) The concrete shell shall be designed for loads and load combinations as specified in IS 4998 (Latest). Limit State method shall be used for design of shell.
- 2) The concrete shell shall support all platforms, which in turn supports the flues. The beams supporting the platform shall be made to rest on the shell by making a pocket in the shell with necessary embedding/fixing arrangements. Suitable Elastomeric bearing pads shall be provided below the beams. These bearing pads shall be designed against temperature effect and horizontal shear due to seismic loads. The diameter of flue and RCC wind shield will be so chosen as to allow for sufficient clearance to accommodate essential accessories like staircase, elevator, test probes etc. The space should also ensure adequate ventilation around the flue and maintenance requirements.

Uniform concrete grade shall be used for chimney wind shield.

- 3) The maximum deflection at the top of the chimney for both static and dynamic cases shall not be more than $H/500$ where H is the total height of the windshield above top of the foundation.
- 4) The static modulus of elasticity of concrete for various concrete grades shall be taken as specified in IS: 456.
- 5) The dynamic modulus of elasticity of concrete for various concrete grades shall be taken as lower values in the range of values specified in IS: 4998 (Latest).
- 6) Reinforcement in the shell shall be provided as per IS: 4998 (Latest). However, the maximum spacing of reinforcement shall not be more than 250 mm both ways in the shell and 300 mm for foundation raft.

For Vertical reinforcement, Minimum reinforcement shall be 0.25% of the overall concrete section under consideration. For circumferential reinforcement, minimum reinforcement shall be 0.20% of the overall concrete section under consideration subject to minimum of 4cm^2 per metre height of the stack. The circumferential reinforcement shall be placed nearer to the faces of the shell.

While providing vertical reinforcement steel in the shell, the total number of vertical bars shall be continued till such height when alternative bars can be discontinued. However, reduction of bar diameter along the height is permissible. At any section of the shell vertical bars shall be uniformly spaced. Non-uniform spacing of vertical bars is not acceptable.

One third of the vertical bars can only be lapped at one section.





- 7) Openings in the shell shall be provided for ductworks, access doors, ash channel and ventilation system etc. as required. The maximum width of opening shall be limited to an angle of not more than 30° subtended at the center of the concrete shell.

The total plan area of the openings at a particular section shall not be more than 15% of the plan area of concrete shell at that location. The opening size for the purpose of stress calculations shall be taken as 1.1 times the actual width of the opening. The extra reinforcement around opening shall satisfy the requirements given in the latest versions of the following documents and the highest shall be provided.

- a) IS: 4998
 - b) ACI 307
 - c) Reinforced concrete chimney and tower by G.M. Pinfold.
- 8) Suitable foundation to support the staircase shall be provided as required.
- 9) Staircase and elevator enclosures shall be provided keeping provision for a rack and pinion type electrically operated elevator.
- 10) Minimum thickness of wind-shield at top of chimney shall be 300 mm and the minimum thickness of the RCC shell at the top of base raft shall be 850mm. However, thickness of shell shall be matched with guidelines provided in IS: 4998 (Latest version).
- 11) Uniform Grade of concrete shall be adopted throughout the height of chimney shell.

6.02.00 **Steel Flue**

6.02.01 **Material**

- 1) The liner shall be of corrosion resistant steel type “COR-TEN B” of minimum 10 mm thick. Top 10m length (below roof) or length equal to 2 times flue diameter whichever is larger shall be provided using material confirming to AISI:316L or BS:1449. Above the roof also the liner is of AISI:316L/BS:1449 and the height of the flue shall be as per the design requirement. Acid resistant Borosilicate brick lining shall be provided at inside face of the flue.

Design of Steel Liners

Steel liners shall, in general, be designed meeting the requirements of the document, “Design and construction of steel chimney liners”, prepared by Task committee on steel chimney liners, Fossil power committee, Power





division published by ASCE-1975.

- 2) Stainless steel liners shall be fabricated using material conforming to AISI 316L or BS: 1449. Grade of steel shall be equivalent to BS: 1449 (Part 2) 316 S.12.

At Load Bearing and Side Restraints of Flues

Load bearing insulation assembly to have (i) a properly machined mild steel plate with recess at its top for seating PTFE (Poly Tetra Fluoro Ethylene) sheets conforming to BS:5400 (ii) saddle plate (MS) in the middle having stainless steel plate fixed at its bottom surface and lead / elastomeric sheet at top, and (iii) top plate formed of two numbers insulation blocks each made of minimum 50 mm thick rigid, non-combustible asbestos fibre reinforced lime-silica board (SINDANYO BLOCKS NATURAL GRADE CS-51) or equivalent bonded to mild steel plates at top and bottom. For side restraints assembly of insulation blocks of SINDANYO Natural Grade CS-51 or equivalent and stainless steel plate shall be used. All stainless steel in these assemblies shall conform to AISI-316L and mild steel to IS:2062. SINDANYO BLOCKS or equivalent shall be suitable for operation at 320oC and shall primarily satisfy the following physical properties:

- i) Minimum compressive stress prior to onset of compression yield of not less than 12 N/sq.mm.
 - ii) Minimum shear strength of 30 N/sq.mm when tested in accordance with BS:3497.
 - iii) Thermal conductivity shall not exceed 0.67 W/m Deg.C at a mean temperature of 200°C and its coeff. of linear expansion not to exceed 1.2×10^{-5} per Deg.C.
 - iv) Adhesive used for bonding purposes shall be of material with equivalent high temperature properties as approved Foundation Engineer. It may be of "Fortafix Fiborclad Adhesive" as manufactured by Fortafix Ltd., England or equivalent.
- 3) Materials for Expansion Compensator (Fluroelastomeric) shall be suitable for flue gas condition specified elsewhere. The expansion compensator shall be provided at minimum two levels.

The fabric for expansion compensator shall comprise several layers of materials given below in order from the gas side:

- i) Two layers of insulation, each consisting of heavy weight glass cloth impregnated with graphite suspension, having an approximate weight of 1.00 kg/Sq.m.
- ii) A continuous filament glass cloth coated both side with flouro-elastomer having an approximate weight of 1.5 kg/Sq.m.





- iii) Two layers of PTFE (Poly Tetra Flouro-Ethylene) film of minimum thickness 0.15 mm each.
- iv) A layer of glass felt of minimum thickness 10 mm and an approximate weight of 1.5 kg/Sq.m.
- v) The scope of providing expansion joint between chimney transition duct and FGD duct at the battery limit shall be under the scope of FGD contractor.

4) **Flue Support Arrangement:**

- a) The support brackets and bearing assembly shall be welded to the locally thickened portion of the flue and in turn support the flue on the support platform. The arrangement shall cater for thermal movements of liner elements in a smooth and easy manner.
- b) The support arrangement shall typically consist of the flue support shoe (which is part of the flue), flue support bracket which is connected to the shoe by a precision bolted connection. The bracket in turn is welded to a bearing assembly. The bearing assembly is later bolted to the support beams available.
- c) Suitable restraint brackets and stop plates of MS shall be provided to avoid excessive movement, and keep the different units of the bearing assembly in position.
- d) Restraint and support brackets shall also be provided for the bottom supported portion of the flue which rests on the support platform provided at the base to cater for bearing and restraint requirements.

6.02.02

Design

Flue size (internal diameter) shall be selected considering flue volume, head loss in duct, exit loss etc. Vibration frequency shall be maintained more than (+/-) 20% away from the fundamental frequency of the windshield. If this is not possible then a dynamic analysis shall be undertaken treating the flue and the windshield as a coupled system.

Following factors of safety shall be maintained for different load combinations:

Operating Condition	Load Combination	Minimum Factor of Safety
Normal	D+T+W/4	2.0
Abnormal Environmental	D+T+W or E	1.5





Abnormal Operation	$D+T^*+W/4$	1.333
D, W, E = Dead, wind and earthquake loads T = Loads due to temperature T* = Loads due to abnormal operating temperature		

The liner shall be designed to safely withstand service loads as well as stress induced during its handling, transport and erection. At locations where the flue is stayed, frictional forces develop due to thermal movement. These forces shall be accounted for in design of the flue. The flue liner thickness shall be determined from structural and corrosion potential considerations. However, the minimum thickness of the liner determined from structural consideration alone shall not be less than 6 mm and corrosion allowance adopted shall not be less than 4 mm and thereby minimum total installed thickness of flue liner shall not be less than 10 mm.

6.02.03 Liner Hood / Cap

The liner hood shall be fabricated from 6 mm thick stainless steel sheets of grade 316 L. The hood shall completely cover the annular area packed with insulation material between the stainless steel flue and cladding. This will prevent exposure of insulation from the surrounding flue gas environment. Special care should be taken to provide sufficient overlap of the stainless steel flashing cladding over the shield plate attached to the chimney roof cap. This is to ensure that adequate protection is achieved for the liner within the wind shield from the elements. All sections of the cladding / flashing shield plate shall be anchored in place with stainless steel bolts / nuts. Slot holes shall be provided to make allowances for differentials expansions/ movements. The Chimney cap shall slope towards the inside of the chimney at an angle of approximately 30° to the horizontal.

6.03.00 Internal Platforms

6.03.01 Internal platforms shall be provided at levels matching with the External Platforms and as required meeting all functional requirement and shall be supported on structural steel beams. Structural steel beams shall be supported on the shell (by making pockets on the shell). The platforms shall be located at approximately 40m intervals throughout the height of the chimney. Total nos. of internal platforms will be 4 nos.(minimum). Except for the roof slab, all the platforms shall be provided with MS chequered plate of min. 8mm o/p. All recesses of the intermediate platforms must be protected with hand railings of minimum 1.2m height. Handrails will consist of 40 NB pipes conforming IS: 1161 for vertical posts. Horizontal rails of 32NB will be provided at the top and at 500 mm intervals below from top, Toe guard plate with 50x6mm flat at bottom. At least three horizontal pipes will be provided for handrail.

6.03.02 The platforms shall be designed for the following loads:

- 1) Dead loads, weight of flue, Weight of lining, if supported on the platform.





- 2) Live load on the platforms during operation and maintenance @ 500 Kg/m² (min).
- 3) Construction loads.
- 4) Thermal loads.
- 5) Effect of wind / seismic loads.

6.03.03 The platforms shall also be designed to accommodate displacements caused by the thermal deformations, shrinkage and creep.

6.03.04 The steel girders supporting the platforms shall be provided with shear connector. However, for the design of plate girder the composite section of slab and beam shall not be considered. Deflection of girders shall not exceed span / 600. However, deflection for secondary beams supported on main girder may be span / 325. All the girders & beams, platforms and handrails shall be provided with 3 coats of heat and acid resistant epoxy paint over one coat of epoxy primer.

6.03.05 Corrosion allowance 2 mm (min.) shall be kept in the design of plate girders.

6.03.06 The minimum thickness of web shall be kept as 12 mm for fabricated plate girders carrying the flue load.

6.04.00 **Foundation**

Only PILE foundation shall be provided.

The bidder shall use the borelog data of Owner's Existing Soil Investigation Report for reference purpose. Moreover, bidder is at liberty to carryout suitable number of borehole tests at site to assess the pile capacity values for pile foundations and the Net Safe Bearing Capacity values for design of open foundations prior to quote. After contract award, the design of foundation shall be carried out as per the provisions of IS-456 & IS-2911.. The design, size, depth of the foundation shall be based on the approved soil investigation report of the successful Bidder/Owner's soil investigation report whichever is conservative.

The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. Worst of the forces calculated as per codal requirements and forces obtained from wind tunnel study shall be considered as design forces for final design of foundation. The Foundation shall be checked for overturning and sliding considering maximum and minimum vertical load. There shall be no uplift under the foundation for any loading condition. No allowance shall be made for wind and seismic load combination. Grade of concrete for foundation shall be minimum M 35. Necessary provision shall be made in foundation design for supporting





the transition duct.

The pile cap may be treated as raft and annular raft with hollow inside is not permitted. Pile cap diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. Minimum reinforcement shall not be less than 0.12% (of overall section under consideration) in either face and in each direction. Wind and earthquake shall be treated as normal load and no enhancement of stress is permitted on this account in soil, concrete and steel. No tension will be allowed under the foundation during earthquake and wind. Foundation will be designed for SRSS of final moments (as explained above) of along wind response and across wind response. The effect of water table shall be considered and the foundation shall be checked for overturning and sliding for minimum and maximum vertical loads. Ground water table shall be considered at finished grade level for foundation design. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 300mm.

One intermediate layer of reinforcement in pile cap shall be provided where the thickness exceeds 2000 mm. Two such intermediate layers of reinforcement shall be provided where the thickness of pile cap exceeds 4000 mm. Such reinforcement in each direction shall not be less than 0.06% of cross-sectional area of pile cap

Concrete pouring sequence shall be such that no cold joints occur.

The shrinkage reinforcement shall not be less than 16mm deformed bars at 600mm centres. In addition, vertical chair bars at 600 mm centres shall be provided to support these bars.

6.05.00 **Outer Platforms**

6.05.01 Outer platforms shall be of RCC. It shall be provided as per Directorate of Air Routes & Aerodromes (DARA) Circular for locating Aviation Warning Lights and for other maintenance puposes. The platforms shall be equally spaced at a spacing of 40 m (maximum). Additional platforms for sampling ports, access doors, clean out doors etc. shall have to be provided as per requirements. Total nos. of external platforms will be 4 nos.(minimum).

6.05.02 The minimum clear width of the platforms shall be 1200 mm and a live load of 500 Kg/m² shall be considered for design in addition to the dead loads and other incidental loads, if any.

6.05.03 Hand railing shall be provided all around external platforms including hood platform using 40 NB stainless steel pipes of grade 304. The spacing of railing posts shall not be more than 1500 mm center to center. The height of hand railing shall not be less than 1250 mm. There shall be three horizontal railings of 32NB about 450 mm, 850 mm & 1250 mm respectively above platform level.

6.05.04 32 mm dia G.I. drainage spouts shall be provided in platforms for drainage of





rainwater.

6.05.05 150 mm dia DI RWDC pipe (minimum two in numbers) shall be provided to carry rainwater from roof to discharge point at ground level. The number of down take pipe shall be decided as per design.

6.06.00 **Roll – Up door**

6.06.01 Flue duct erection opening of sufficient size considering all aspects shall be provided by the bidder. After erection, it may be covered with rolling shutter suitably.

Electrically operated rolling shutter of size 3.0m x 3.50m (minimum) shall be installed at Finished Floor level along with guides, hood, hardware, weather baffles, combination end locks and wind locks, mechanism and accessories as required for proper operation and weather protection. The complete details and specifications of rolling shutter shall conform to IS: 6248 (latest edition) “Metal Rolling Shutters & Rolling Grills”. RCC ramp shall be provided for access from the road/ground level.

6.06.02 The door shall be installed in accordance with the details and the manufacturer’s directions. When installed, the door shall be free from warp twist, or distortion and shall be lubricated and adjusted to operate freely and smoothly.

6.07.00 **Personnel / Access Doors**

6.07.01 A steel personnel door of size 1200mm x 2100mm shall be provided for access to the windshield at grade level in addition to the rolling shutter with RCC ramp approach.

6.07.02 Steel Personnel doors of size 1200mm x 2100mm shall be provided in shell for access to external platforms,, at different levels so that aviation warning lights could be approached for maintenance purposes.

6.07.03 One air tight Access door at roof of size 750 mm x 1000 mm in stainless steel shall be provided to cover access opening at + 145 M. floor.

6.07.04 The doors shall be hinged and provided with positive locking device. The hinges required for connecting the door with door frame shall be heavy duty steel butt hinges conforming to IS: 1341 (latest).

The size and number of hinges required for each door shall be decided as per the overall weight of the door for smooth and trouble free operation under service conditions. The minimum size of the hinges shall be not less than 150 mm.

6.08.00 **Inspection / Maintenance Doors**

6.08.01 Two numbers steel leak proof doors (lined internally with borosilicate blocks) of





size 750 x 1000 mm and 750 x 600 mm shall be provided diametrically opposite in each of the flues at each of those levels where internal platforms are provided.

6.08.02 Proper sealing arrangement shall be provided in the doors to ensure leak tightness.

6.09.00 **Hatches**

6.09.01 Hatches shall be provided as required for erection and maintenance. Suitable covers along with proper locking arrangement may be provided, if required, for safety of personnel.

6.10.00 **Elevator & Staircase**

Elevator and staircase within windshield (having two steel flues) shall be provided.

The travel of the lift shall be up to the last platform below the roof. Access to roof from the top most internal platform shall be provided through Galvanized MS Cage Ladder and access hatch with appropriate cover openable from inside the windshield.

Staircase with handrails for chimney will be supported from top of chimney raft & from all internal platforms and not with chimney shell. The staircase will serve all the intermediate levels. Staircase will be constructed in Structural steel. The stair will stop at last internal platform. The staircase in no case will be inclined more than 35° angle with horizontal plane. Width of staircase shall be 1200mm. The riser will be 175 mm and tread of minimum 250 mm The MS handrails shall conform to IS 1161. The staircase with handrails shall be applied three coats of high build heat resistant Epoxy paint over one coat of epoxy primer(refer cl 6.11.00).

6.11.00 **Painting**

The entire inside surface of the chimney shell, horizontal surface of the shell at top, underside of roof slab, top exposed surface of external platforms etc. shall be painted with acid & heat resistant black bituminous paint conforming to IS:158 (not less than four coats including one prime coat). Total dry film thickness (DFT) shall not be less than 150 micron.

Entire external surface of the windshield shall be painted in alternate band of signal red and white colour starting with signal red colour at the top and in line with aviation requirements. out of which top 50m shall be painted with acid and heat resistant polyurethane paint and rest of the outside surface shall be painted with synthetic enamel paint conforming to IS:5410 in alternate bands of red and white colour. Total DFT shall not be less than 150 micron (three coats over one coat of primer). Each coloured band shall be approximately 30m wide.

External painting shall have acid and heat resisting properties conforming to IS-





158. Total dry film thickness (DFT) shall not be less than 150 microns. The top of shell at the roof level shall be painted with three coats of approved paint over a thin coat of the same paint. The overall DFT shall be at least 230 microns.

All steel surfaces (inner & outer) shall be painted with 3 coats of high build heat resistant epoxy paint over one coat of epoxy primer (total DFT of 250 to 290 microns). Special steel surfaces (such as Corten Steel, Stainless Steel, Hot insulated surfaces etc.) shall not be painted.

Surface preparation and paint application shall be in accordance with manufacturer's recommendation.

6.12.00

Sampling & Test Ports for Emission Monitoring

Analyzers for Continuous Emission Monitoring System (CEMS) will be mounted on the chimney as per latest CPCB guidelines. Following tapping points for sampling and test ports will be provided at different elevations of the chimney as per CPCB norms. CEMS analyzers will be procured in a separate FGD system package.

Flue gas sampling ports for on line Emission monitoring instruments & Test Ports for local sampling & testing shall be provided at access platform level.

One (1) nozzle shall be provided for mounting of SO_x, NO_x, CO, CO₂, and Moisture analyzer (Combined analyzer).

One (1) nozzle shall be provided for mounting of O₂ analyzer.

One (1) nozzle shall be provided for Mercury analyzer.

Two (2) nozzles in diametrically opposite position shall be provided for mounting of dust density / Opacity analyzer.

Two (2) nos tappings 180 degree apart and making 45 degree angle with vertical axis shall be provided for ultrasonic type gas flow measurement..

Temperature Test pockets with a stub of size M33X2 shall be provided for installing thermowell for flue gas temperature measurement & correction for opacity measurement.

In addition to the above sampling ports for instrumentation purpose there shall be four gas sampling ports on the stack at 90 degree apart with flanged ends for manual sampling & testing.

one nozzle shall be provided made of 200 NB Duplex stainless steel pipe and projected approximately 200 mm outside the steel flue wall with an upward inclination of 5 Degree with the horizontal plane of flue can for flue gas pressure measurement at location as per the C&I requirement.





Access plat forms shall be provided at all the sampling points or ports and thermo well installation points around the flue can to carry out maintenance works. The working plat forms shall be provided 1.25 meter below the sampling points or ports and thermo well installation points.

Contractor shall furnish the arrangement drawings for the sampling and test points for owner's approval during engineering.

6.13.00 **Acid Proof / Chemical Resistant Protection to Roof**

The chimney roof slab shall be of RCC supported on a grillage of structural steel beams. The roof will be sloped outwards for drainage of water. Acid proof / chemical resistant tiles bedded on acid proof / chemical resistant mortar shall be provided for the protection of the roof slab. The intervening space between tiles shall also be filled up by acid proof / chemical resistant grouts. The mortar shall be acid proof mortar – Potassium Silicate type resistant to Sulphuric Acid as per IS: 4832 Part I & IS: 4441. The mortar shall be used immediately after mixing.

Tiles shall be made of clay, feldspar or quartz and vitrified at high temperature in ceramic kiln. These shall be unglazed, free from deleterious material and shall conform to IS: 4457. Iron oxide in the raw material shall not exceed 2%. These shall show a fine-grained homogeneous fracture when broken and shall be sound, true to shape, flat and free from flaws and other manufacturing defects. Dimension of the tiles shall be 198.5 x 198.5 x 35 mm minimum. Depth of groove on the underside shall not be more than 3 mm. Compressive and tensile strength of tiles shall not be less than 70 N/sq.mm and 3.5 N/sq.mm respectively.

6.14.00 **Roof Drainage**

Rain water outlets and down comers to be provided for roof drainage shall be heavy DI pipes and fittings conforming to IS: 8329 .

6.15.00 **Transition Ducting**

The battery limit of incoming flue gas duct and center line elevation of duct shall be determined as per layout given by FGD package Contractor. Terminal point for incoming flue gas Duct shall be 1.0 (one)m away from the Chimney shell at about 45m height (to be confirmed at the detail engineering stage after getting confirmation from FGD package vendor). Flue gas Expansion joint and Transition piece for Rectangular duct to Circular flue shall be provided by Chimney package Bidder. The change in direction from horizontal to vertical for transition duct shall follow smooth turning. Apart from construction of chimney windshield and internal platforms, supply and erection of flue cans from the downstream of the terminal point up to final discharge point in atmosphere shall be under the scope of Chimney package. The duct work profile and the guide vanes as required to be done by Bidder shall be so configured and sized to achieve the desired flue gas flow characteristics and to minimize flue gas pressure losses. The duct work and its supporting structures if any shall be





designed for the most onerous of the possible combinations of gravity loading, seismic loading, flue gas pressure loading and thermal loading. Like in the case of steel liners, the minimum thickness of duct plates shall not be less than 10 mm in any case from structural condition and corrosion allowance point of view. Clean-out door shall be provided below the each flue for the removal of ash.

The design, detailing, fabrication, erection etc. of the platform, structure supporting the transitional duct within the RCC windshield shall be under the scope of Chimney package bidder.

6.16.00 Flue Openings and Duct Work

The concrete shell at flue duct entry shall be adequately protected against high temperature by cast able refractory lining and the gap between the shell and duct shall be properly sealed off by any other suitable seal.

The openings in the windshield shall be sufficiently reinforced to withstand design loads. Similarly the openings in steel flues shall be properly reinforced for receiving the flue ducts.

The R.C.C. shell shall provide support for duct work from the expansion joint to the chimney liner.

Exposed ductwork shall be insulated and lagged to protect equipment & prevent injury to personnel. The insulation and wire mesh shall be secured to the lagging by means of pins or prongs welded to the exterior sheet and spaced on intervals not exceeding 450 mm in both the directions. The insulation shall be impaled over the pins or prongs, wire mesh applied over the insulation and the insulation and mesh shall be held in place with speed clips.

6.17.00 Lightning-Protection System

The air terminals shall be fabricated from a solid rod made of Alloy C276. Conductors, attachments, and fasteners located within the top 25 ft (8 m) of the stack should be lead-covered.

6.18.00 Electrical Conduit

All rigid steel conduits and accessories within the top 30 m on the exterior of the stack should be installed with a bonded PVC jacket. Conduit located within the top 100 ft 30 m on the exterior of the stack should be supported with Type 316 stainless-steel unistruts, clamps, and fasteners. Because of corrosion resistance and weather-tight requirements, all electrical boxes located within this area should be NEMA 4X.

7.00.00 Wind Tunnel Test for Chimney

Wind Tunnel Test for the RCC Stack is to be carried out. A model test has to be performed in a wind tunnel to predict aerodynamic behaviour of the prototype





**Tender Specification
for
Chimney**

**NLC TamilNadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

without strakes. The technical details, location and other features of the Stack to be tested are to be provided along with necessary drawing showing stack outline, General arrangement Plan, section, elevation and mass details of the stack and other details as required for the test.

The tests shall be carried out on the model of the proposed Stack considering without flue and with flue conditions. The model test shall be carried out without strakes. Interference effects due to presence of adjoining structures to be studied along with other required parameters including detailed aerodynamic behaviors.





Tender Specification
for
Chimney

NLC TamilNadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: B

SUB SECTION: II

**TECHNICAL SPECIFICATION FOR CONSTRUCTION
OF REINFORCED CONCRETE CHIMNEY**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part B; Sub Section: II
Technical Specification for Construction
of Reinforced Concrete Chimney



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**VOLUME: II-B
SECTION: I**

PART: B

SUB SECTION: II

**TECHNICAL SPECIFICATION FOR CONSTRUCTION
OF REINFORCED CONCRETE CHIMNEY**

1.00.00 CONSTRUCTION BY SLIP-FORM METHOD

Chimney construction shall be carried out using slip form shuttering technique. Type of Slip-form proposed shall be indicated in the offer with sketches, drawings and description as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour shall be indicated. The chosen scheme shall be of a past proven design. Performance record of the scheme shall be submitted with the offer for review and verification by the owner / consultant.

The Bidder shall furnish a brief but comprehensive description indicating the plan, programme and method of work proposed, for the approval of Owner at the time of submitting Bid. This description shall include the following items:

- i) Type and description of Slip-form equipment and its accessories.
- ii) Design of scaffolding and staging.
- iii) Description of materials including admixtures to be used for construction.
- iv) Manpower planning, construction space required, standby arrangement.
- v) Rate of Slip-forming.
- vi) Proposed workability requirement of concrete and type of cement & admixture to be used.
- vii) Quality assurance programme.
- viii) Method of Transportation of material
- ix) Method of curing and rectification of defects.
- x) Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint.
- xi) Contingency solution for unplanned interruptions.





- xii) Time of completion.

Also refer to Subsection-I of Vol-II B-Section-I, Part-B.

2.00.00 GUIDELINES FOR SLIP FORM METHOD

Notwithstanding what have been specified in earlier clauses, following guide lines are being presented which shall be kept in view by intending Bidder, while quoting for Slip-form method of construction:

1. Care to be taken to prevent dragging of concrete along with upward movement of the shuttering. For this purpose following steps may be adopted:
 - a) Shutter plates shall be smooth and shall be thoroughly cleaned. Before fixing them in position all the surfaces that will be coming in contact with concrete to have a coat of epoxy paint.
 - b) In areas where concrete thickness is 750 mm or more rate of pouring should be such that minimum slipping of shuttering is 100 mm per hour.
 - c) Mix design shall be such that it shall be self-lubricant at the contact face of shutter and concrete and thus reduce friction. Suitable cement of approved manufacturer (conforming to relevant I.S. Specification) may be used for the purpose. An optimum ratio of coarse/fine aggregate should be established to suit the purpose depending on availability of aggregates.
 - d) Mix design also shall be such that a slump of 50 mm is achieved at the point where concrete is placed under an ambient temperature of around 40 °C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 minutes. Suitable retarding agent or plasticizers of approved manufacture may be added in mix to meet this requirement. These admixtures shall be properly identified by preliminary tests both for performance and for compatibility with particular type of cement proposed to be used.

Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40°C.

2. Care must be taken to prevent twist, which, predominantly occur in the initial stages because of low slipping rate, in the horizontal plane of Slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person shall exclusively be assigned for this purpose.





3. Every endeavor shall be made to prevent any tilt in the shutter assembly. To achieve this, following steps need to be taken:
 - a) Performance of jacks shall be closely monitored and any defective one shall be immediately replaced. Difference in levels of opposite jacks at any instant of time shall not exceed 5 mm.
 - b) Loading on Slip-form truss/yokes shall be evenly distributed as far as practicable.
 - c) Sleeve through which jacking rod passes has to be of sufficient length so that later gets an uniform clearance and does not get any chance to tilt. Sleeve should have a minimum wall thickness of 3.25 mm and should be such that jacking rod gets a maximum clearance of 1 mm to 1.5 mm around.
4. For taper walled chimneys overlapping of shutters which are kept to effect the tapering, needs careful attention otherwise these may be filled with concrete slurry.
5. In designing the mix following aspects should be borne in mind:
 - a) Cement used should have an initial setting time of not less than 50 minutes and preferably should have a specific surface around 3600 Sq.Cm. per gram.
 - b) Coarse and fine aggregates should be well graded and rounded. These help to keep down water/cement ratio and also offers better lubrication between concrete and shutter surface. 20 mm down size of coarse aggregates should preferably be used unless reinforcement detailing calls for lesser size aggregates.
 - c) From the point of view of creep, shrinkage as well as initial setting property of concrete, cement content should be controlled perfectly as per mix design.
 - d) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slip form proceeds should be between 0.1 to 0.2 Newton/ Sq.mm.
6. Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter - only in exceptional cases. At least two nos. standby vibrator units should always be maintained on top of working deck at all time during the entire period of slip form operation. Concrete shall be laid in layers and vibrated properly to have sound concrete without any honey combs.
7. It is preferable to have membrane-curing compounds sprayed on fresh





surfaces emerging out of shutter panels for ensuring proper curing at great heights.

In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is always advisable to have a stand-by pump for effective utilization of the system.

8. Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc.

It is desirable that jacking system, based on which the entire slip form system works, should consist of jacks 3 Tonne / 6 Tonne capacity and a hydraulic pump with necessary pipe connections.

Spacing of yoke legs should preferably be kept within 2 meters to prevent overloading on jacks and consequent failure resulting in twist of the formwork.

Jacking rods should be of 25 mm diameter for 3 Tonne Jacks and 32 mm diameter for 6 Tonne Jacks.

9. At least 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump along with a set of loose pipes in perfect working condition on top of working deck.
10. In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slip form yoke.
11. For effective utility of this technique following areas need careful attentions at the very conceptual stage:
- Detailed quality assurance programme.
 - Advance Planning and preparations.
 - Arrangement for on-site supervision and adequate access facilities.

12. Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, description and frequency of various checks and tests for Slip form technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared beforehand by executing agency and to be





approved by Consultant before starting the actual work.

13. Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement.

Vertical reinforcements should be kept vertical by providing suitable holders within the slip form system.

14. It is desirable to have a break of at least one day for every two weeks of continuous operation. Such break should be utilized for various maintenance activities, removal of jack rods etc.
15. Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete.

For movement of personnel supervising the work a separate hoist must be arranged for.

16. The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system along with slip form.
17. Winches for lifting men and material and mixers, if located within unsafe area around chimney, should be protected by adequate shelter from possible damage.
18. Proper tele-communication system has to be established between the personnel working on top of Chimney and control room below.
19. A small laboratory shall be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube-testing machine may also be installed at site for getting quick feed back results.

Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers.

20. In case of interruption in the course of slipping, the formwork shall be brought up above the already poured concrete and following measures shall be taken:

Provision of a key and additional reinforcement at the junction of new and old concrete.





- a) Slip form system shall be lowered to have a minimum overlap of 100 mm or so over previously cast concrete. Chipping of old concrete surface to remove laitance and washed with water jet and cleaned with compressed air and thereafter pouring a layer of neat cement grout.
 - b) Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Consultant.
 - c) Neatly finishing the interface of old or new concrete as soon as it comes out of shutter panel.
21. It is preferable to suspend the construction work under high wind condition.
22. It is of utmost importance that for effective implementation of this system a Consultant fully conversant with Slip form technique with enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid-level supervisory staff, skilled workers and operators.
23. Operation of slip form method of construction is a continuous one and it demands continuous inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity.
24. While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities shall be carried out under the guidance of a qualified and trained safety Consultant.

Safety measures as listed below, but not limited to only these shall be adhered to:

- a) Safety helmets and belts to be provided to all supervising staff and workers.
- b) Safety nets to be provided below both inside and outside platforms as instructed by the safety Consultant.
- c) Hand railing and toe guard to be provided around all openings and platforms.
- d) Regular maintenance of equipment, checking of hoists, scaffoldings etc.
- e) Passenger hoist must have multiple ropes.





- f) Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the Specification and to be operative in case of sudden power failure Emergency standby generator must be kept ready during the entire period of slip form method of construction.
- g) Emergency vehicles, first aid facilities must be kept ready during the entire period of work.

All The safety appliances including wire ropes shall be got inspected periodically by the approved statutory agencies and the inspected reports shall be submitted to the owner.

25. Permissible construction tolerances shall be limited to the following:

Variation in wall thickness : (-) 5 mm, (+) 25 mm

Variation from Design Diameter : (+) 25 mm or (+) 12.5 mm per 3 m dia. whichever is larger, but in no case more than (+) 75 mm.

Out of Plumb in General : 1 in 1000 of height subject to a maximum of 200 mm.

Also refer to Subsection-I of Vol-II B-Section-I, Part-B.

3.00.00 CONCRETE

3.01.00 Trial Mix, Grades of Concrete

At least three weeks before commencing any concreting in the work the Bidder shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the work. A clean dry mixer shall be used for mixing and the first batch shall be discarded.

For guidance in designing the mix, standard tables for maximum allowable water-cement ratio, minimum cement content, maximum proportion of aggregates and limits of consistency may be used by the Bidder. The Bidder's design mix shall fall within limits of the following tables :-

- i) Strength requirements of concrete : Table-2 of IS:456.
- ii) Concrete Mix Proportion : Table-9 of IS:456.
- iii) Minimum cement content/Cu.m. of finished concrete shall be as per IS-456.(however for all RCC works the minimum cement content shall be 400kg/cum)





- iv) Limit of consistency : Refer Table in Item 3.0.4 of this specification.
- v) Cement/Total Aggregate Ratio : As per the following table.
- vi) Design mix as per IS 10262.

**MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES
OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO
(FOR GUIDANCE)
CEMENT/TOTAL AGGREGATES RATIOS**

Workability	Water/ Cement Ratio	Ratio by weight of cement to gravel aggregate		Ratio by weight of cement to crushed stone aggregate	
		20 mm. size	38 mm. size	20 mm. size	38 mm. size
Very Low slump 0-25 mm.	0.4	1:4.8	1:5.3	1:4.5	1:5
	0.5	1:7.2	1:7.7	1:6.5	1:7.4
	0.6	1:9.4	1:10	1:7.8	1:9.6
	0.7	1:10	1:12	1:8.7	1:10.6
Low slump 25-50 mm	0.4	1:3.9	1:4.5	1:3.5	1:4
	0.5	1:5.5	1:6.7	1:5	1:5.5
	0.6	1:6.8	1:7.4	1:6.3	1:7
	0.7	1:8	1:8.5	1:7.4	1:8
Medium slump 50-100mm.	0.4	1:3.5	1:3.8	1:3.1	1:3.6
	0.5	1:4.8	1:5.7	1:4.2	1:5
	0.6	1:6	1:7.3	1:5.2	1:6.2
High slump 100 - 175 mm.	0.4	1:3.2	1:3.5	1:2.9	1:3.3
	0.5	1:4.4	1:5.2	1:3.9	1:4.6
	0.6	1:5.4	1:6.7	1:4.7	1:5.7
	0.7	1:6.2	1:7.4	1:5.5	1:6.5

NOTE -1:

Notwithstanding anything mentioned above, the cement /Total aggregate ratio is not to be increased beyond 1:9 without specific permission of the Engineer.





NOTE - 2:

It should be noted that such high aggregate cement ratios will be required or concretes of very low slump and high water- cement ratios which may be required to be used in mass concrete work only.

The above figures are for guidance only, the actual cement/ aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes

For each grade of concrete, a set of eighteen cubes shall be made. Of these not more than six may be made on any day and further, of the six cubes made in one day not more than two cubes may be made from any single batch. Nine of these cubes each representing a different batch of concrete shall be tested at the age of seven days and remaining at twenty-eight days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with the relevant IS Specifications. The test shall be carried out in laboratory approved by the Consultant. If the average strength of the concrete cubes falls below the requirement, the method described above shall be repeated till acceptable results are obtained. The method may have to be repeated whenever there is a significant change in the quality of any of the ingredients for concrete, at the discretion of the Consultant.

Also refer to Subsection-I of Vol-II B-Section-I, Part-B.

3.02.00 **Batching of concrete**

For controlled concrete, only weigh batching shall be allowed. All concrete ingredients, except water, shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer-in-charge.

3.03.00 **Mixing of Concrete**

Materials for concrete shall be emptied in rotation into the mixer. When all the ingredients are in the drum, the drum will rotate for one minute for dry mixing. After that water shall be added in measured quantities in the manner specified. The mixer shall then rotate for at least two minutes, or at least forty revolutions or until there is apparent uniform distribution of the materials and till the mass is uniform in colour. The entire content of the drum shall be discharged before the ingredients for the succeeding batch are fed into the drum. The mixer shall be thoroughly cleaned to the satisfaction of the Engineer-in-charge, before a different quality of concrete is put through the mixer and also at the end of day's work.

3.04.00 **Workability of Concrete**

The degree of workability necessary to allow the concrete to be well





consolidated and to be worked into the corners of formwork and around the reinforcement and embedment, and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. 15 mm. to 40 mm. slump in chimney works shall be adopted subject to Engineer's approval unless stated otherwise (vide serial 1(d) of clause no. 2.00.00). The usual limits of consistency for various types of structure are given below:

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm. with standard concrete		Use for which concrete is suitable
	Min.	Max	
Very Low	0	15	Large mass concrete work with heavy compaction equipment.
Low	15	35	Uncongested wide and shallow RCC structures.
Medium	35	65	Deep and wide RCC structures with congestion of reinforcement and inserts.
High	65	100	Very narrow and deep RCC with congestion due to reinforcement and inserts.

NOTE : The above table is for guidance only. Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer-in-charge.

With the permission of the Engineer-in-charge, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately, to keep the ratio of water to cement same, as adopted in trial mix design, for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively, where facilities exist or if required by the Engineer-in-charge, the compacting factor test, in accordance with IS:1199, shall be carried out.

3.05.00 **Placing and Compaction of Concrete**

Concreting shall proceed in a manner directed by the Engineer-in-charge, concrete shall be placed in forms as soon as possible but in no case later than twenty minutes, after mixing.





The height of any single lift of concrete, for different structural members, shall be decided by the Engineer. The concrete shall be placed in the forms gently and not dropped from a height, which may cause segregation of aggregates. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken an initial set.

The concrete, after placing, shall be consolidated only by power driven vibrators. The vibrators shall be of a make and size, approved by the Engineer. In using the vibrator, the standard practice and the Engineer's directions, shall be followed.

Vibration shall begin as soon as one batch of concrete has been placed and shall continue till the entire section being poured has been thoroughly consolidated.

To secure even and dense surfaces, free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic, without damaging or endangering the stability of the formwork.

A sufficient number of spare vibrators including petrol vibrators shall be kept readily accessible to the place of deposition of the concrete to assure adequate vibration in case of breakdown of those in use.

3.06.00 **Curing of Concrete**

Curing of exposed surface of concrete shall commence immediately after the concrete has set. Exposed sides shall be covered with canvas etc. immediately after stripping of forms, and curing shall be continued for a period of not less than 14 days, reckoned from the date and hour of completion of concreting. All surfaces of the pour shall be kept wet with water at all times after concreting and till the curing period is over. The Bidder shall plan and employ proper equipment and sufficient labour considered adequate by the Owner under able supervisor for curing and all cost for this purpose shall be borne by him.

The Bidder may adopt spraying of curing compound as per manufacturer's recommendation.

3.07.00 **Construction Joints**

In concreting the chimney shell one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts the horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Bidder for forming joints or chipping and





cleaning them or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Bidder shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance.

3.01.08 Ordinary Concrete

Ordinary concrete like lean concrete shall be of nominal mix as per relevant clauses of IS: 456.

4.00.00 REINFORCEMENT

4.01.00 Bending of Reinforcement

All bars shall be carefully and accurately bent by the Bidder in accordance with approved Drawings and bar bending schedules. Special care shall be taken to ensure correct lengths of laps. The bars shall not be bent or straightened in any manner that will injure the bars or impair the bond between reinforcement & concrete. Bends and hooks are to be provided as laid down in the IS: 2502.

4.02.00 Placing

All reinforcement shall be placed and maintained in the position shown in the drawings. Bidder shall provide approved type of cover blocks to suit the requirement of the Drawings. Where reinforcement is to be provided on two faces of the shell, the Bidder shall provide adequate number of separators, with the approval of the Engineer. Any additional support to the reinforcing cage, if required at the time of concreting, shall also be provided, to the satisfaction of the Engineer. Lapping of reinforcement as specified in the drawings or as directed by the Engineer, shall be provided. Laps shall be staggered and too many laps shall be avoided. Welded laps shall be provided only when directed or approved by the Engineer-in-charge.

4.03.00 Fixing of Reinforcement

18 SWG annealed steel wire of two strands shall be used as binding wire. Bar crossing one another and contact laps shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.

5.00.00 CHIMNEY STEEL AND METAL WORK

5.01.00 General

All workmanship shall be of best practice in modern structural shops, and shall conform to the provisions of the IS:800 and other relevant IS Specifications, unless otherwise specified.





5.02.00 Fabrication

Rolled materials, before being used for fabrication, shall be straight and shall be within the tolerance laid down in the IS:852. Straightening, if necessary, may be done by mechanical means and if required, by applying localised heat, the temperature of the material not exceeding 600 Deg.C locally. Cutting of mild steel members shall be effected by power saw or gas cutting. If gas cutting is used, allowance shall be made in working out the effective length, based on the shop drawing and templates. Care shall be taken in gas cutting so that the member does not bend or warp. Edge preparation for welding may be done by gas cutting with necessary precautions and cleaning. Holes shall be drilled with power drill. Arrangement shall be made for clamping the member to be drilled so that the member is not displaced while drilling is in progress. When two or more members are to be drilled together, all the parts shall be clamped together. After drilling they shall be separated and burs shall be removed with power driven hand grinder. Bolt-holes shall not be formed by a gas-cutting torch.

5.03.00 Assembly

Riveting, bolting and welding shall be carried out as per requirements laid down in IS: 800. Shop assembly of elements of platforms or the entire platforms, brackets and similar items if required and/or asked for by the Engineer, shall be arranged so as to check the accuracy of fit. Necessary temporary supports like props, cross bracings etc. shall be provided to keep the parts in place both for mock up and at the time of erection. Each steel piece shall bear erection marking, written in paint.

5.04.00 Painting

If steel and iron members are to be painted as per contract, it shall be done as per requirement laid down in IS: 800. A coat of shop painting shall be applied to all steel and metal work, unless stated otherwise. All steel ladder, platforms, balconies, stairs, hand railing, frames, doors etc. which are specified for painting shall be painted as specified in section I of Part B/volume II B.

All paints shall be of make and shade as instructed and approved by the Engineer. Necessary test certificates, manufacturer's literature and samples shall be submitted to the Engineer for his approval, before bulk purchase is made.

The metal surfaces which are to be painted shall be prepared properly by rubbing, washing, treating prior to application of paint as per paint manufacturer's specifications and as per relevant IS Specifications.

5.05.00 Galvanizing

wherever galvanizing specified in contract, shall be hot dip galvanized in accordance with American Society for Testing and Material Specification ASTM 123 or IS:2629 - Recommended practice for Hot- Dip Galvanising of





Iron and Steel.

Members to be galvanized shall be cleaned thoroughly, to the satisfaction of the Engineer, by the process of pickling. Pickling shall be carried out in an acid bath containing sulphuric or hydrochloric acid of suitable and adjusted concentration and temperature. Pickling process shall be completed by rinsing the members thoroughly in warm water.

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath and it shall meet all the requirements when tested in accordance with IS:2633 and IS:4759. The zinc coating shall be of uniform thickness. If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage and if so directed, the galvanizing may have to be redone in the similar manner stated above.

5.06.00 Erection

Erection of structural members and Stainless steel Chimney caps shall be done as per requirement of IS: 800. The Bidder shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be provided by the Bidder. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Bidder and shall be taken into account in quoting the rate.

5.07.00 Stainless steel Chimney Cap

The stainless steel cap, fitted at the top of the chimney, shall be of thickness not less than 10 mm. This shall preferably be a single cap covering both the concrete shell and the lining, with the segments bolted together securely and properly anchored inside the concrete in such a manner as to form a complete annular unit, allowing for unequal circumferential and vertical expansion and contraction of concrete shell and lining and for deflection of shaft due to wind.

All bolts, nuts, washers, rag bolts and other fasteners as required for fixing stainless steel cap shall be of bronze material. Gaps between segments are to be filled with asbestos mill-board or fibre-glass packing. Cap is to be assembled as sloping outside and to match with the dimensions specified in approve drawings, before despatch to site.

6.00.00 INSULATIONS AND PROTECTIVE TREATMENTS

6.01.00 Borosilicate Lining

As per Vol-II-B Sec-I-Part B-SS-I.





6.02.00 **Paint**

The outside face of the Chimney shell, unless specified otherwise, shall be painted with alternate bands of signal red and white colour, out of which top 50M shall be painted with acid and heat resistant polyurethane paint and rest of the surface shall be with synthetic enamel paint confirming to IS 5410. The quality shall be approved by the Engineer. Necessary samples shall be submitted to the Engineer for his approval. The surface of the shell shall be prepared as per paint manufacturer's specification. In addition, care shall be taken that the surface is free from stain, honey comb and any rough and uneven surface. The joints between two shuttering and two lifts of shuttering shall be so prepared that any unevenness, if by chance exists, shall be removed. If one coat of paint is not sufficient to give the required finish, the Bidder, at his own cost, shall repaint the surface, until the Engineer is satisfied with the workmanship. The paint shall conform, unless otherwise stated, to IS: 5410. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for approval.

6.03.00 **Lightning Protection System**

The lightning protection system to be installed on the chimney by the Bidder shall be strictly as per specifications and shall satisfy the requirements described in Electrical Part of this SPEC in Vol-II B-Section-III.

6.04.00 **Aviation Obstruction Lighting System**

The Bidder shall supply and install the aviation obstruction Lighting system on the chimney strictly as per specification and shall consist of the items described in Electrical Part of this SPEC in Vol-II B-Section-III.





Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: I

SPECIFIC DESIGN REQUIREMENTS
[CIVIL]



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: I
Specific Design Requirements [Civil]



**Tender Specification
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**VOLUME: II-B
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PART: C

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SPECIFIC DESIGN REQUIREMENTS [CIVIL]

1.00.00 INTRODUCTION

This section outlines the followings:

- a) A brief description of Soil Characteristics.
- b) Design considerations for Reinforced Concrete Structures.
- c) Design considerations for Foundations.
- d) Roads.

2.00.00 GEO-TECHNICAL SYSTEM

Detail soil investigation, as required, to be carried out for foundation design of various facilities.

Soil characteristics and parameters to be adopted in final design, the successful bidder is required to do detail geotechnical investigation work as part of the contract to verify/generate data so required.

It should be noted that nothing extra whatsoever on account of variation between soil data annexed in this specification and that found by detailed geotechnical investigation to be carried out by bidder shall be payable.

The design of foundation shall be carried out by Limit State or working stress method as per the provisions of IS-456 (Latest) and on the basis of the soil investigation Report done by the Bidder. The type, size, depth of the foundation shall be based on the approved soil investigation report of Bidder/Owner's soil investigation report whichever is conservative.

Soil & water samples of the proposed site has high concentration of sulphate (as per soil report) & has also concentration of chloride in the sample & hence adequate measure to take care of this as per IS 456 will be considered.





3.00.00 LOADS

Design, loading, load combinations, Concrete grades, cover to reinforcements etc. for Chimney structure shall be as per SUBSECTION-I of Volume: IIB, SECTION-I PART-B.

All structures and portions thereof shall conform to the latest revision of relevant Indian Standard specifications and also to the various other technical requirements.

All structures shall be designed to sustain within the stress limitation as specified in the Code, all dead loads plus assigned live, equipment, wind, seismic or other design loads.

a) Dead Loads

Dead load shall include the weight of all structural components and architectural appurtenances incorporated in the structures plus hung loads and any other permanent, externally applied load. This should also include equipment dead load. The content of tanks, Ash storage bins shall be measured at full capacity for this purpose. Hung loads and the contents of tanks and bins shall be listed separately so that they can be excluded from dead load when dead loads are acting as stabilizing loads for uplift.

The following unit weight of material shall be considered for computation of loads. Loads given in IS: 875 (part-I) shall be made use of for material not listed below.

Materials	Unit weight
Plain cement concrete	: 24.0 kN /cum
Reinforced cement concrete	: 25.0 kN /cum
Structural steel	: 78.5 kN /cum
Brick work	: 19.0 kN /cum
Cement plaster	: 21.0 kN /cum
Floor Finish	: 24.0 kN /cum
Coal	: 12.0 kN /cum
Fly Ash	: 16.0 kN /cum
Bottom Ash	: 16.0 kN /cum

b) Live Loads

Live loads in different areas shall include dust loads, minor equipment loads, cable trays, small pipe racks/hangers, operation/maintenance loads etc. The loads considered shall not be less than those specified in IS: 875 (Part 2).

The loads listed hereunder are minimum loads for the areas involved. Special use areas shall be investigated and loading revised upward as necessary.





Hung loads shall be based on minimum loading equivalents of 1.0 kN/Sq.m for piping and 0.5 kN/Sq.m for electrical, ventilation and air conditioning. Loadings resulting from concentrations of facilities in specific areas shall be substituted where listed base loading is excluded.

Electrical Building

- a) Roof:
- | | |
|--|--|
| Inaccessible roof (Flat) : | 1.5 kN/Sq.m + hung loads,
if any + 0.5 kN/Sq.m (dust load). |
| Accessible roof where
equipments are placed : | 5 kN/Sq.m + hung loads,
if any + 0.5 kN/Sq.m (dust load). |
| Accessible roof
Without equipments : | 1.5 kN/Sq.m + hung loads,
if any + 0.5 kN/Sq.m (dust load). |
| Inclined roof : | As per IS: 875 (Part 2) |
- b) Stairs & Platforms : 5.0 kN/Sq.m
- c) Corridors : 5.0 kN/Sq.m
- d) Removable gratings,
chequered plates,
walkways etc. : 5.0 kN/Sq.m
- e) Ground Floor : 10 kN/Sq.m
- f) Cable Spreader Floor : 7.5 kN/Sq.m
- g) Office Floor : 5 kN/Sq.m
- h) Switchgear room : 15 kN/Sq.m
- i) All other Floors : 10 kN/Sq.m

iii) Underground Structures/Trenches/pits

Minimum surcharge shall be 20 kN/Sq.m. For structures in vicinity of roads and heavy vehicular movement surcharge shall be considered as applicable as per loading specified elsewhere in this specification.





Trenches/pits inside building shall be designed for a surcharge equal to Live Load intensity of Ground Floor or 15 kN/Sqm whichever is greater.

iv) **Covers for Trenches / Channels**

Self-weight of top slab and a uniformly distributed load of 100 kN/Sqm on each panel or one 100 kN central point load, whichever is critical, shall be considered. At road crossings and entrance of the buildings wherever vehicle/crane movement is expected, the covers shall be designed for vehicular movements as per IRC standards

v) **Roads**

Design of roads shall be in accordance with Indian Road Congress standard IRC 15 & IRC-58.

vi) **Road Culverts and its allied structures including Road Crossing of Trenches.**

At all road crossings RCC box culverts along with manholes on both sides shall be used. Such road culverts and its allied structures including R.C.C. Pipe Crossings & Road Crossing of Trenches shall be designed for Class `AA` loading (wheeled and tracked both) and to be checked for Class `A` loading as per IRC standards.

Reduction in Live load as per provision of IS: 875 shall not be permitted.

The areas covered with equipment shall be designed on the basis of weight of equipment (flooded/operating) in addition to a uniform live load of 5.0 kN/Sqm or specifically defined live load whichever is greater.

Foundations and fixing arrangements for items of equipment, which generates vibration, shall be designed to prevent transfer of such vibrations to the adjoining structures.

For loads caused by moving equipment over the floor for installation, consideration shall be given to the shoring of beams and floor, from floors below.

c) **Equipment Loads**

- i) Loadings (both static and dynamic) of equipment obtained from the manufacturer's certified drawings of the specified equipment to be furnished. Where design of structures supporting minor equipment other than those included above has to proceed, the loadings shall be estimated from similar jobs or catalog data.
- ii) All equipment, tank and piping design loadings shall include Hydraulic Testing loads.
- iii) Air and gas duct loadings shall include weight of insulation, duct attachments, dust accumulation loads, seismic, wind and other





loads as applicable.

- iv) Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as developed from the crane weights and wheel loads.

Unless otherwise specified, the vertical and horizontal loadings shall conform to the applicable sections of the IS specifications.

- v) Weight of equipments, ducts, tanks, pipes, conduits etc. supported by structure shall include maximum possible loading conditions i.e. flooded material contents and associated impacts, test loadings, anchorage and constraint effects.
- vi) All structural components shall be designed to accommodate anticipated concentrated loads which shall or may be applied during the life of the plant.

Where both concentrated and uniform loads cannot act simultaneously, the structure or component shall be analyzed for both conditions of loading and shall be designed for most critical condition.

- vii) Jet forces resulting from guillotine type pipe ruptures shall be considered in the design, if it is of high magnitude. Jet force to be considered shall be equal to the product of the pipe cross section and the internal design pressure applied on an area equal to the pipe cross section.

d) Wind Loading

Wind loading shall be in accordance with Indian Standard Code IS:875 (Part 3) (Latest Revision) for a basic wind speed of 39 m/sec. upto a height of 10 metres above mean ground level. Terrain Category-2 shall be considered for all structures.

Risk coefficient (k_1) shall be considered as 1.06 for all structures.

Notwithstanding the design wind forces calculated based on above parameters, the structures shall not be designed with a wind pressure less than 1.5 KN/sqm

e) Seismic Loading

The lateral forces shall be established in accordance with the recommendations of IS: 1893 (Latest Revision). The site falls in Zone-II as identified in the map in IS: 1893 and hence seismic forces would be considered accordingly for the structures and buildings. Importance factor shall be taken as per latest versions of IS: 1893 parts.

f) Temperature Loads





The structures shall be designed to withstand stresses due to fifty (50) percent of the total temperature variation. The total temperature variation for temperature loading should be taken as two thirds (2/3) of the average annual variation in temperature. The average maximum annual variation for this purpose shall be taken as the difference between the mean daily minimum temperature during the coldest month of the year and mean daily maximum temperature during the hottest month of the year.

Minimum ambient temperature = 20.8°C

Maximum ambient temperature = 36.5°C

Expansion and contraction due to changes of temperature of materials of a structure shall be considered and adequate provision shall be made for the effects produced as per provision in the relevant IS codes.

g) NOT USED

h) Earth Pressure Load

Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable).

In addition to earth pressure and ground water pressure, etc., surcharge load shall also be considered for the design of all underground structures including channels, sumps, cable & pipe trenches, etc., to take into account the vehicular traffic in the vicinity of the structure. Intensity of Surcharge Load shall be considered as 2.0 t/sq.m in general unless mentioned otherwise.

i) Crane, Monorail & Elevator Loads

Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as per crane vendor's data. All lifting beams and monorails shall have their design loads increased for impact factor as mentioned hereinafter. For frame analysis, the lateral crane surge shall be applied on one side of the frame at a time and in either direction.

Impact Factor

Loads for cranes, hoists and elevators shall be taken as per IS: 875 / IS: 807 (Latest Revision). The minimum impact factor to be used in design shall be as follows:

Crane loads





- a) For vertical force, an impact factor of 25% of the maximum crane wheel load for crane girder 10% for column and foundation.
- b) A lateral crane surge of 10% of the weight of the trolley plus lifted load applied at the top of each rail.
- c) A horizontal surge of 5% of the maximum static wheel loads of the crane applied at the top of the rail in longitudinal direction.

Monorail loads

- a) Impact factor of 10% of lifted load of hoist for monorail and support design
- b) Impact factor of 25% of the lifted load for electrical pulley and support design

Elevator

A 100% of the lifted load including elevator live load plus the cab weight for the elevator support beams.

j) Construction Loads

The integrity of the structures shall be maintained without use of temporary framing struts or ties and bracing as far as possible. However, construction or crane access considerations may dictate the use of temporary structural systems. Special studies shall be made and documented to ensure stability and integrity of the structures during any periods involving use of temporary bracing systems.

k) Other Loads

Stresses imparted to structures due to differential settlements, variation of water table, erection and maintenance load, creep and shrinkage shall also be considered in design of all structures.

l) Thrust Load

Thrust blocks shall be designed against the thrust load from pipe lines considering the test pressure in the pipe lines and as per the relevant IS Code with adequate factor of safety.

3.01.00 Stability of Structures

Design shall be checked against buoyancy due to the ground water during construction and maintenance stages for structures like underground tanks, pits trenches, basements, etc. Minimum factor of safety of 1.20 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loading. For purpose of calculating downward load due to any





overburden, only the mass located vertically above the projected area shall be taken into consideration.

All building sub-structures including pump houses shall be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases shall be taken as mentioned in IS: 456 and other relevant IS codes. However, following minimum factor of safety shall be followed.

- a) Factor of safety against overturning due to wind, seismic or other lateral load shall be 1.5 minimum.
- b) Factor of safety against sliding shall be 1.5 minimum.
- c) Factor of safety against uplift due to hydrostatic forces shall be 1.20 and due to any other loads shall be 1.5.

Stability of the structure shall also be investigated for loading conditions during construction, repair or other temporary measures. Lower factor of safety may be used for such loading conditions as per relevant IS codes.

In case where dead load provides the restoring force, only 0.90 times characteristic dead load shall be considered. Imposed loads shall not be considered as restoring force.

Ground water table shall be considered at Plant Finished Grade Level for design of foundations and all underground structures.

3.02.00

Load Combinations

Buildings and structures shall be designed to resist the load stated in the previous section acting in the following combinations.

While designing consideration shall be given to the following load combinations:

- i) DL + LL
- ii) DL + LL + PL + Equip \pm TL
- iii) DL + LL + PL + Equip + Cb + CtLA \pm CS \pm TL
- iv) DL + LL + PL + Equip + Cb + CtLB \pm CS \pm TL
- v) 0.9DL \pm EL (for DL only) \pm TL
- vi) 0.9DL \pm WL1 \pm TL
- vii) 0.9DL \pm WL2 \pm TL





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- viii) $DL + *LL + PL + Equip + Cb + Ct \pm EL \pm TL$
(* Appropriate portion of LL which is considered for working out EL shall only be taken)
- ix) $DL + LL + PL + Equip + Cb + CtL1 \pm (CS1+WL1) \pm TL$
- x) $DL + LL + PL + Equip + Cb + CtL1 \pm (CS1+WL2) \pm TL$

Where the above loads are :

DL = Dead load of structures, floors, walls etc.

LL = General live load on floors

PL = Pipe Load

Equip = Equipment loads

Cb = CraneBridge

Ct = Crane trolley positioned at middle of bridge

CtLA = Crane trolley + Load near one row

CtLB = Crane trolley + Load near other row

CtL1 = Crane trolley + Half load lifted at centre of bridge

CS = Crane surge for full load

CS1 = Crane surge for half load lifted

WL1 = Wind load with internal suction

WL2 = Wind load with internal pressure

EL = Earthquake load

TL = Temperature load

Appropriate impact factor shall be considered as per IS:875 (Part 2) (Latest Revision) while calculating crane loads.

In calculating wind loads, appropriate internal thrust / suction shall be





considered along with external pressures as per IS:875 (Part 3) (Latest Revision). All possible load conditions considering external and internal pressures shall be considered in analysis and design for the combinations as stated above to assess worst effect on whole structure as well as its components.

Seismic Load shall be considered in all three directions for analysis and design of Structures.

Appropriate allowable increase in permissible stresses as per IS codes, may be taken only under normal loads along with wind and seismic conditions. However, members which are designed primarily to resist wind, no increase in permissible stresses shall be permitted.

Applicable load factors to be used for design of RCC structures by Limit State Method as per IS: 456.

Load Combinations for Underground Structures

Following loading conditions shall be considered in addition to the loading from super structure for the design of sub-structure.

Only liquid pressure from inside and no earth pressure and ground water pressure, and surcharge pressure from outside (applicable only to the structures which are liable to be filled with water or any other liquid).

Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

Design shall also be checked against buoyancy due to ground water during construction and operation stage. Minimum factor of safety as per IS:3370 (Latest Revision) against buoyancy shall be ensured considering empty condition ignoring superimposed loads.

3.03.00 Design Concepts

Wind and seismic forces shall not be considered to act simultaneously.

'Lifted Load' of crane shall not be considered during seismic condition.

For design of all underground structures/foundations, ground water table shall be considered at the Finished Ground Level.

If R.C.C. floors and roofs except those cast over metal decking are assumed to act as diaphragm transmitting lateral loads to braced bays then main beams/girders shall be provided with shear connectors. However, whenever large/more number of cutouts is provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab. Shear connectors shall also be provided over beams having R.C.C. slab on one side and opening /chequered plate / grating on other side.





For calculation of seismic load, equipment load shall be considered as Dead Load.

Whenever any structure under this contract shall carry or receive additional load from the work of any other contract, the structures under this contract shall be provided with sufficient margin to carry the above load, details of which shall be finalized during detail engineering.

Gratings / chequered plates shall not be considered as restraining members for compression flange of beams/girders. Diaphragm action shall also be not considered in design. Adequate horizontal bracings to be provided.

4.00.00 DESIGN OF REINFORCED CONCRETE STRUCTURES BY BIDDER

- a) Reinforced Concrete Structures shall be designed in accordance with the requirements of IS-456 (Latest Revision) & IS-875 (Latest Revision) or as specified in this specification for all possible combination of loads, e.g. dead load, live load, crane loads, wind or seismic loads, soil loads and surcharge loads, etc. The grade of concrete for RCC shall be M-35 for all structures.
- b) Corrosion inhibitors of approved make will be used in Concrete for all RCC work (excepting for storm water drains) as per standards and manufacturers specification.
- c) Minimum cement content for RCC for aggressive environment like Tuticorin shall not be less than 400 kg/m^3 for M-35 and above grade.
- d) If concentration of Sulphate (measured as SO_3) exceeds 0.5% in soil or 1200 ppm in ground water, sulphate resisting cement may be used for all substructures.

The following grades of concrete as per IS-456 shall generally be used.





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Sl. No.	Class	Grade of conc.	Min. cement content Kg/Cum	Max. free water cement ratio
1.	i) Plain cement concrete used for and fill between two foundations one above other at different levels	M15	240	0.6
	ii) Lean concrete below all foundations, plinth beams, drains, pits, etc.	M10	-	-
2.	i) Plinth protection.	M35	400	0.55
	ii) Paving, Grade slab, RCC drains and trenches	M35	400	0.55
3.	i) Reinforced concrete for super structure and foundation	M35	400	0.45
	ii) RCC roads	M35	400	0.5
4.	Pre-cast concrete	M35	400	0.5
5.	Piles	M35	400	0.5

- e) Reinforcing bars shall be TMT bars of minimum grade Fe 500 CRS conforming to IS-1786 (Latest Revision) and Mild Steel bars conforming to IS: 432 (Grade I) (Latest Revision) of vendor approved by Owner. Fe500D/Fe550 CRS may also be used but the design is limited to Fe500only.

Test certificate for reinforcement steel will be obtained from recognized agency, before using . If the steel is purchased by the contractor, purchaser may desire to check the testing of the same & the contractor will arrange it in approved laboratory at his own cost”.

- f) Higher grade of Ordinary Portland cement namely Grade 43 conforming to IS: 8112 (Latest Revision) shall be used for construction of all RCC structures and foundations as recommended by Owner. However the Ordinary Portland cement (Grade 53) may be used wherever necessary and directed by Owner.

Grade of cement shall be OPC and for underground structures, it shall be minimum 5% -8% C3A content.

- g) The design of R.C. Structures shall be carried out by limit state or working stress method as per the provisions of IS-456 (Latest Revision).
- h) NOT USED.
- i) Grouting material:





Grouting shall be done with Conbextra GP-2 or equivalent for Equipment foundations and Conbextra GP-1 or equivalent for all structural column bases. For pipe-supports grouting shall be done with 1:1:2 cement-sand - 6mm down stone chips. Grouting thickness shall be 50mm minimum.

- j) For reinforcement detailing IS: 5525 (Latest Revision) and SP:34 shall be followed.
- k) The walls shall be provided with reinforcement on both faces for sections 150 mm or more, even if not required from design consideration.

5.00.00 FOUNDATION DESIGN

The design of foundation shall be carried out by Limit State or working stress method as per the provisions of IS-456 (Latest Revision) and on the basis of the soil investigation Report done by the Bidder.

Foundation shall be checked for safety against overturning, sliding and uplift. High ground water level up to final graded ground level shall be considered to take into account buoyancy effect.

Pile foundation, shall be designed in accordance with IS: 2911(Part-I / Sec-I, II and III) (Latest Revision).

The type, size, depth of the foundation shall be based on the approved soil investigation report of Bidder/Owner's soil investigation report whichever is conservative.

5.01.00 Foundations

Top of RCC foundation for the steel columns shall generally be kept at a lower level so that the column base plates together with gussets and stiffeners remain below the finished floor level. Foundation levels of some columns shall have to be suitably lowered to accommodate underground services, pits, trenches, etc.

Common foundation should be provided for columns both side of the expansion joint and shall be designed for loading on both columns.

Foundations for Buildings and structures shall be designed to resist forces and moments, caused by vertical loads and by wind or seismic loads, based on static and dynamic analysis done for those structures. The foundation sections shall be sized and reinforced adequately for moments and shear stresses.

5.02.00 NOT USED

5.03.00 Pile Foundations

For Pile Foundations, following shall be adhered to:





- a) The pile foundation shall be of RCC, Cast-in-situ bored, pile as per IS: 2911 (Latest Revision). Bored piles shall be installed by using rotary hydraulic rig. Three-stage flushing of pile bore shall be ensured, by airlift technique or any other internationally accepted method duly approved by the Owner.
- b) The minimum diameter of pile shall be 450mm for cast-in-situ piles. The uplift and lateral load capacity shall be established by field test.
- c) Only straight shaft piles shall be used. Minimum cast length of pile above cut-off level shall be 1.0 m.
- d) The bidder shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter like (SPT & SCPT value, set criteria etc.), reinforcement for job as well as test piles, etc.) for Owner's approval.
- e) The piling work shall be carried out in accordance with IS: 2911 (Relevant part) (Latest Revision) and accepted construction methodology. The construction methodology shall be submitted by the Bidder for Owner's approval.
- f) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be as under:

Vertical	}	As specified in IS 2911 for each mode.
Lateral		
Uplift		

The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of compression test the method of loading shall be cyclic as per IS: 2911 (relevant part) (Latest Revision).

- g) Routine pile load tests shall be performed for each diameter/allowable capacity of pile.

The routine tests on piles shall be conducted up to test load of one and half times the allowable pile capacity. The Owner shall approve piles for routine load tests. Routine load tests may be done by conventional method as per IS: 2911 (Part-4) (Latest Revision).

In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Bidder shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required,





without additional cost to the Owner.

- h) Testing of piles and interpretation of pile load test results shall be carried out as per IS: 2911 (Part-4) (Latest Revision). Bidder shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory/ institute prior to their use. Additional measurement for pile movement shall also be done.
- i) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the piles for routine load test and not intended to replace the use of static load testing.

5.04.00

Other Requirements

- i) In case of high ground water table, for excavations comprehensive dewatering arrangement shall be required. Scheme for dewatering and design with all computations and back-up data of dewatering and sheet piling shall be submitted for Owner's information.
- ii) The founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches/channels.
- iii) Excavation for open foundations (for floors, roads, drains, trenches, etc.) shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil at founding level during excavation, the same shall be removed and compensated by PCC of Grade M10. The foundation pits shall be maintained dry during the complete construction period by means of suitable dewatering systems.
- iv) Backfilling, around foundations shall be carried out with approved material in layers not exceeding 30 cm thickness and each layer shall be compacted to 90% standard proctor density for cohesive soil and to 75% of relative density for non-cohesive soils.
- v) Excess/surplus excavated material and debris shall be disposed of by the Bidder as per the instructions of the Owner up to a lead of about 10 km.
- vi) CBR tests for rigid / concrete pavement design shall be carried out by Bidder after earth filling has been completed, if applicable.

6.00.00

GENERAL REQUIREMENTS

6.01.00

Minimum Thickness of Structural Elements

The following minimum thickness shall be followed:

Pile caps 900 mm





Suspended floor / slab / walkways / canopy slabs, etc.	150 mm
Ground floor slab/Grade slab (non-suspended)	200 mm
Water Retaining slabs / walls	200 mm
Walls of Cable / pipe trenches / underground pits / Lauder walls and base slab	150 mm
Drain walls and base slab	125mm
All footings (including raft foundations)	300 mm
Parapets	125 mm
Sunshades at edge	75 mm
Pre-cast trench cover slabs / floor slabs / louvers	100 mm
Paving	200 mm
Basement walls and base slab	250 mm

The above are minimum requirement only unless otherwise mentioned elsewhere in the specification.

From fire resistance point of view minimum thickness of reinforced concrete members shall be as per Fig 1 or Table 16a of IS 456 (Latest Revision) or specified above, whichever is higher.

6.02.00 **Minimum Heights for Pedestals/Encasements of Steel Columns**

Pedestals to Steel Columns for building structures:

In case the top of pedestal is kept at a lower level so that the column base plate together with gussets and stiffeners remain below finished floor level (FFL) the column bases as well as the column sections shall be encased in concrete above FFL as per following.

- a) Open area : 300 mm above paved level
- b) Covered area : 300 mm above FFL

Stair and ladder pedestal shall be kept 200 mm above the finished floor level.

Pedestals to Steel Columns for Equipment structure:

- a) Equipment in open area : as required (300mm min)
- b) Equipment in covered area : as required (150 mm min)





- c) Structures and equipment : as per vendor's data
supplied by vendor subject to minimum as
specified above

6.03.00 **Ground floor slab-on-grade**

Ground floor slab-on-grade shall be minimum M-35 grade RCC construction laid over minimum 75mm thick lean concrete of M10. Minimum consolidated 230mm thick graded stone or laterite (63mm down size) soling with interstices filled with sand/gravel and compacted mechanically, shall be provided as sub-base below lean concrete. The sub-base shall be laid over rammed and well-compacted earth fill.

The ground floor slab shall be of minimum 200 mm thick with double layer reinforcement of 8mm (minimum) dia at the rate of 200 (maximum) c/c both ways.

6.04.00 **Stairs, Platforms, Handrails**

All internal stairs, platforms and walkways shall either be of RCC or Structural Steel with minimum 8mm thick chequered plate construction. All outdoor stairs, platforms and walkways shall either be of RCC or Structural Steel with minimum 40mm thick GI grating (40x6 mm flats).

All handrails made of MS hand railings with 40 mm NB (medium) main posts and 32 mm NB (medium) as horizontal rails as per IS:1161(Latest Revision) with toe guard of 150x6mm shall be provided. Painting shall be as per sec I /SS I/part B/vol II B.

7.00.00 **ROADS**

Geometric design of road shall be done in accordance with Indian Road Congress Standard. The ruling gradient for roads in longitudinal direction shall be 1 in 30. Normally roads shall have much flatter gradient. Transverse camber of 1 in 40 shall be provided.

A detailed CBR test, shall be carried out as per the procedure outlined in IS-2720 (Part-XVI) (Latest Revision). CBR test shall be carried out in remoulded soil samples under soaked condition.

All roads shall have hard shoulder on either side of carriageway. Shoulders shall have sufficient load bearing capacity to support loaded trucks. A flatter slope of 1 in 30 shall be provided on shoulders.

RCC box culverts, as suitable, shall be provided at road crossings for drainage, LP pipes, Ash pipes, cable trenches, waterline pipes, etc. All culverts shall be designed for IRC class "AA" loading and checked for class A loading.

At all road crossings RCC box culverts along with manholes on both sides shall be used. Such road culverts and its allied structures including R.C.C.





Road Crossing of Trenches shall be designed for Class `AA` loading (wheeled and tracked both) and to be checked for Class `A` loading as per IRC standards.

All roads with shoulder and drains shall match with the existing connecting roads, shoulder and drains.

8.00.00 DRAINAGE

Open RCC rectangular drains shall be provided for storm water. The thickness of sides & bottom shall be minimum 125 mm or as per design considerations whichever is higher. Drains shall have minimum 600mm base-width. RCC culverts shall be provided for road crossing. Drains shall be provided on both sides of the roads.

Inside surface of the drain will have smooth neat cement finish over with screed concrete. Invert of the drain shall be decided in such a way that the water can easily be discharged to the recommended nearest outfall outside the plant boundary. The minimum slope of the drain shall be 1:1000 longitudinally to take care of the silting problems. It is recommended to maintain the maximum velocity within 1.2 m/sec.

9.00.00 MISCELLANEOUS DESIGN / CONSTRUCTION CRITERIA

- 1) All masonry walls from ground floor shall be placed on reinforced concrete grade beams. However, light internal partitions may be placed on ground floor slab. The grade beam shall be partially above FGL and partially below FGL. Minimum embedment of the grade beam below grade level shall be 300 mm.
- 2) The steel column base plate along with stiffening gusset plates shall not be protruded above floor level.
- 3) For exposed areas, the columns shall have a minimum encasing of 300 mm above paved level.
- 4) Ramps for building entrance shall be cast in situ RCC slab and the slope of ramps shall not be more than 1 (vertical) to 8 (horizontal).
- 5) Minimum 75 mm thick lean concrete M-10 shall be provided below all underground structure, trenches etc., to provide a base for construction.
- 6) The building shall have RCC framed super structure. All walls shall be non-load bearing infilled panel walls.
- 7) Duct banks consisting of PVC/GI conduits for cables shall be provided with reinforced concrete encasing of M35 grade. The minimum depth of top of duct bank from grade level shall be 500mm.





- 8) Angles 50 x 50 x 6 mm (min.) with lugs shall be provided for edge protection all round of cut-outs/opening in floors, edge of drains supporting grating covers, edges of RCC cable/pipe trenches, manholes supporting covers, supporting edges of pre-cast covers and any other places where breakage of corners of concrete is expected.
- 9) Trenches located outside building shall project at least 100mm above the finished formation level so that no storm water shall enter into the trench. The bottom of the trench shall be sloped suitably for draining out the collected water into the sump pit. The pre-cast covers shall be of minimum M-35 grade and shall not weight more than 65 kg. Lifting hooks shall be provided in the pre-cast covers. The minimum drainage slope along line shall be 1 in 1000.
- 10) to 13) NOT USED.
- 14) Anti-termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors, switchyard area etc., as per IS-6313 (Latest Revision) and other relevant standards.
- 15) & 16) NOT USED.
- 17) All RCC walls and slabs shall have two layers of reinforcement for section having thickness 150 mm and above.
- 18) All gratings wherever specified, shall be made of 40x6 thick GI flat unless noted elsewhere in the specification. Stairs treads made of grating shall be provided with non-skid abrasive nosing.
- 19) Unless stated specifically elsewhere in this specification, the clear height of roof/beam from finished floor shall not be less than 4.5 M for plant building.
- 20) Unless stated elsewhere specifically in this specification, the finished floor level of the building shall be at least 500 MM above the finished grade level.
- 21) NOT USED
- 22) Sealing of joints shall be done by two part polysulphide sealant and shall be from approved manufacturer conforming to IS: 12118 (Latest Revision). Material shall consist of polysulphide polymer and a curing agent. If any similar design criteria mentioned elsewhere in this specification contradict the above, the stringent of the criteria shall be adopted for design.
- 23) Specific corrosion resistant painting system with protective coatings shall be adopted as per CSIR – CERI recommendations for marine environment with required material, proper application procedure and approved number of coating. Stipulations mentioned in ISO 12944 shall be followed.





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VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: II

**SPECIFIC DESIGN REQUIREMENT
[STRUCTURAL]**



Development Consultants Pvt. Ltd.

**Volume: II-B
Section: I; Part C; Sub Section: II
Specific Design Requirement [Structural]**



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

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**VOLUME: II-B
SECTION: I**

PART: C

SUB SECTION: II

**SPECIFIC DESIGN REQUIREMENT
[STRUCTURAL]**

1.00.00 STRUCTURAL STEEL DESIGN

- a) Structural steel design shall be carried out as per the National Building Code with specific consultation to IS-800 (Latest Revision) unless noted otherwise.
- b) Lateral forces along the length of the building shall be resisted by bracings in horizontal and vertical frames. The transverse lateral load shall be resisted by stiff jointed frame action. Additional bracing or moment connection shall be used to assure stability of the structures.
- c) Structural steel will conform to Grade E350 / E250 of quality (A/BR/B0), semi killed / killed as per IS: 2062 (latest) for rolled steel members or plates. All structural steel plates and sections shall be procured from any make approved by Owner.

For Crane Girder Steel will confirm to Grade E350 / E250 of quality C (Killed).

- d) Shop connections shall be all welded and field connections shall generally be bolted unless specified otherwise. Field bolts, wherever provided, shall be high tensile of 20 mm dia. or of higher diameter and of property class 8.8 as per IS-1367 (Latest Revision) for all major connections. The bolted joints shall be designed for friction type connection and the H.T. bolts shall be tightened to develop the required pretension during their installation. However, the nominal connections in the field like purlins, stairs, wall beams etc. shall be done by 16 mm dia. M.S. black bolts (minimum 4.6 grade) conforming to IS-1363 (Latest Revision) unless specified otherwise.
- e) Welding shall be in accordance with the recommendations of IS-816 - Code of Practice (Latest Revision) for use of metal arc welding for general construction in mild steel and IS-9595 (Latest Revision) - Recommendation for Metal Arc Welding of Carbon and Carbon Manganese Steels. Built-up members shall be fabricated using submerged arc welding procedure unless manual arc welding is specifically required. All butt welds in plate girders and columns shall be full penetration.





All butt welds shall be radiographically or ultrasonically tested as per relevant IS codes and standard practice.

- f) Galvanizing of steel structures (wherever specified) shall be done after all fabrication work is completed. Zinc coating over galvanized surface of structural members and threaded fasteners shall not be less than 610 gm/sqm and 375 gm/sq. m. of surface area respectively. However, fasteners may be tapped or re-run after galvanizing. Threads of bolts and nuts shall be capable of developing the full strength of the bolt. The spring washers shall be electro-galvanized as per IS-1573 (Latest Revision). All galvanizing shall be uniform and of standard quality and shall withstand tests in accordance with IS-2633 (Latest Revision). All galvanizing work shall be done at shop.
- g) Specific corrosion resistant painting system with protective coatings shall be adopted as per CSIR – CERI recommendations for marine environment with required material, proper application procedure and approved number of coating. Stipulations mentioned in ISO 12944 shall be followed (refer vol II B/part B /sec I/SS I).
- h) All welding electrodes shall be of Low Hydrogen type conforming to IS: 814 (Latest Revision). All electrodes, flux, wire etc. shall be of ADOR Welding Ltd., ESAB India Ltd., D & H Secheron Electrodes Pvt. Ltd. Or any other equivalent manufacturer accepted by Owner.
- Alternatively, flux coated arc welding (FCAW) conforming to AWS- can be used.
- i) Minimum preheat & inter pass temperatures for welding over 40mm to 63mm (thickness of the thicker part at the point of welding) shall be 66°C and for over 63mm, it shall be 110°C. However, higher preheat & inter pass temperatures may be required due to joint restraint etc. and shall be followed as per approved welding procedure.
- j) Minimum tests to be carried out during fabrication and erection of structural steel shall be as follows:

Steel

Ultrasonic Test : Plates above 25mm thick shall be subjected to ultrasonic test as per ASTM-A435 or equivalent to check the presence of lamination.

Fillet weld

Dye Penetration Test : 5% of the total length, Dye penetration shall be carried out to the root run.

Butt weld :





Dye Penetration Test : 10% of the total length, Dye penetration shall be carried out to the root run after back gouging

Radiographic Test : Generally splicing should not be provided in tension flange of Bunker Girders and crane girders. Spot radiography shall be carried out on 100% joints in tension zone and 10% joints in compression zone. Minimum 300mm length shall be spot radiographed. When radiograph is not possible ultrasonic test shall be carried out after grinding the surface.

Ultrasonic Test : 10% of all other Butt welds except crane girder and bunker girder shall be subject to spot radiographic test and the entire balance butt weld for ultrasonic test.

k) Connections

Connection of vertical bracings with connecting members and diagonal truss members shall be designed for full tensile capacity of the bracings.

Size of fillet weld for flange to web connection for built up column section shall be as follows:

- Full shear capacity for box section.
- 80% of full shear capacity or actual shear (if indicated in Sellers drawings) or 0.5 times of the web thickness whichever is more for I section. Weld will be double fillet.
- All welds will be continuous. The minimum size of fillet weld shall be as per relevant IS code.

Shear connections shall be designed for 75% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. Design shear force should be more than actual shear.

Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section.

All butt welds shall be full penetration butt welds.

Connection of base plate & gusset members with the columns shall be done considering that total load gets transferred through weld.

All splicing work shall be of full strength. Shop splicing for all sections other than rolled sections shall be carried out by full penetration butt welds. Shop splicing of all rolled sections shall be carried out using web and flange cover plate.

Following connections shall be provided during erection:





Welded Connection

Connection of secondary beam to main beam
Connection of bracing to column
Connection of bracing to longitudinal tie beam
Connection of longitudinal tie beam to column
Connection of spandrel beam to column
Connection of other secondary structures

HSFG Connection (Grade 8.8 bolts)

Splicing of column/transverse frame beam/ longitudinal tie beam
Connection of frame beam to column
Connection of Crane Girder to column
Connection between crane girders
Other major connections

Bearing Type Connection (HT bolts Grade 8.8)

All removable type connections

M.S. bolts (Grade 4.6)

Purlins, stairs, wall beams etc.

2.00.00 LOADS

Design, loading, load combinations, Concrete grades, cover to reinforcements etc. for Chimney structure shall be as per SUBSECTION-I of Volume: IIB, SECTION-I-PART-B.

Loads as defined under Clause 3.00.00 of Sub Section-I (Vol-IIB, Section-I, Part-C) shall be applicable for structures under this package other than Chimney.

3.00.00 LOAD COMBINATIONS

While designing consideration shall be given to the following load combinations:

- i) DL + LL
- ii) DL + LL + PL + Equip \pm TL
- iii) DL + LL + PL + Equip + Cb + CtLA \pm CS \pm TL
- iv) DL + LL + PL + Equip + Cb + CtLB \pm CS \pm TL
- v) 0.9DL \pm EL (for DL only) \pm TL





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- vi) $0.9DL \pm WL1 \pm TL$
- vii) $0.9DL \pm WL2 \pm TL$
- viii) $(DL + *LL + PL + Equip + Cb + Ct \pm EL \pm TL)$
(* Appropriate portion of LL which is considered for working out EL shall only be taken)
- ix) $[DL+LL+ PL + Equip + Cb + CtL1 \pm (CS1+WL1) \pm TL]$
- x) $[DL+LL+ PL + Equip + Cb + CtL1 \pm (CS1+WL2) \pm TL]$

Where the above loads are :

DL = Dead load of structures, floors, walls etc.

LL = General live load on floors

PL = Pipe load

Equip = Equipment loads

Cb = Crane Bridge

Ct = Crane trolley positioned at middle of bridge

CtLA = Crane trolley + Load near one row

CtLB = Crane trolley + Load near other row

CtL1 = Crane trolley + Half load lifted at centre of bridge

CS = Crane surge for full load

CS1 = Crane surge for half load lifted

WL1 = Wind load with internal suction

WL2 = Wind load with internal pressure

EL = Earthquake load

TL = Temperature load

Limit state method to be followed for design of steel structures as per latest version of IS 800. Applicable load factors to be used for Design of Steel Structures by Limit State Method of strength & serviceability as per IS 800 (Latest).





Appropriate impact factor shall be considered as per IS: 875 (Part 2) (Latest Revision) while calculating crane loads.

In calculating wind loads, appropriate internal thrust / suction shall be considered along with external pressures as per IS: 875 (Part 3) (Latest Revision). All possible load conditions considering external and internal pressures shall be considered in analysis and design for each combination numbers (vi), (vii), (ix) & (x) above to assess worst effect on whole structure as well as its components. Analysis shall be done in all three directions X, Y and Z.

In absence of any suitable provision for design loads, any other recognized code of practice may be followed subject to prior approval of the purchaser.

Seismic Load shall be considered in all three directions for analysis and design of Structures.

4.00.00 OTHER SPECIFIC REQUIREMENTS

All steel framed structures shall be either “rigid frame” or “simple space frames” or a combination of two.

Lateral forces shall be resisted by stiff jointed moment connections in rigid frame design. The column bases shall generally be fixed to concrete foundation pedestal by providing moment resistant base detail.

Simple space frame design utilizes single-span beam systems, vertical diagonal bracing at main column lines and horizontal bracing at the roof and major floor levels. Concrete floors shall be considered to provide continuous lateral support to the top (compression) flange of the support beams. However wherever large cut outs (area more than 1.0 sq. m.) are provided in the floor slabs horizontal floor bracing shall be provided. Grating/chequered plate floor shall neither be considered to provide lateral support to the top flange of supporting beams nor to provide a shear diaphragm. Adequate lateral support in the form of shear connector and horizontal bracing shall be provided as required.

Chequered plates shall conform to IS: 3502 (Latest Revision).

All indoor gratings shall be electro-forged type and outdoor gratings shall be welded type. Minimum thickness of grating shall be 40mm x 6mm for indoor installation and outdoor installation. The opening size shall not be more than 30mm x 100mm. All gratings shall be hot dip galvanized @ 610 gm/sq.m.

Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and preferably through shear connection.

Permissible Deflections





The permissible deflections of various steel members under normal loading conditions shall be as specified below. For calculation of deflections in structures and individual members dynamic effects shall not be considered, unless specified otherwise. Also, no increase in deflection limits shall be allowed when wind or seismic load are acting concurrent with normal loading conditions.

Vertical Deflection

- a) For beams supporting dynamic equipment : Span / 500
- b) For beams supporting floors / masonry : Span / 325
- c) For beams supporting pipes (pipe racks) : Span / 400
- d) For roofing and cladding components : Span / 250
- e) For gratings and chequered plates : Span / 200 subject to a maximum of 6 mm

For crane gantries or any member subjected to working loads, the maximum deflection under dead load and live load excluding impact shall not exceed the following values:

- a) For manually operated cranes & monorails : Span / 500
- b) For electric overhead cranes
 - i) Up to 50 t capacity : Span / 750
 - ii) Over 50 t capacity : Span / 1000

Horizontal deflections

The permissible horizontal deflections shall be as per following unless specified otherwise:

- a) Single storey building (without crane load) : Height / 300
- b) Multistoried building (without crane load) : Height / 500
- c) Pipe rack columns : Height / 200
- d) Open Structures : Height / 200
- e) Crane gantry girder due to surge : Span / 2000 limited to maximum of 15 mm
- f) Building main columns at crane rail : Height / 2500 limited to





- level due to action of crane surge load only : maximum of 10 mm
- g) Open gantry columns at crane rail level due to action of crane surge load only : Height / 4000 limited to maximum of 10 mm

Provisions of IS: 800 (Latest Revision) and relevant IS Code shall be followed for limiting deflections of structural elements not listed above.

Minimum Thickness of steel elements

The minimum thickness of various components of a structure and hot rolled sections shall be as follows. The minimum thickness of rolled shapes shall mean flange thickness regardless of web thickness. Structural steel members exposed to significantly corrosive environment (Exposed to open air i.eto Rain, Contact with soil, Coal, Ash, Contact with drained liquid or contaminated water, alkali/acid etc.) shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgment in each instance.

- a) Trusses, purlins, girts and bracing : 6 mm
- b) Columns and beams : 8 mm
- c) Gussets : 8 mm
- d) Stiffeners : 8 mm
- e) Base plates : 10 mm & above
- f) Chequered plates : 8 mm o/p
- g) Grating flats : 6 mm
- h) Minimum thickness of structural members other than gratings and chequered plate directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.
- i) For members Upto 450mm depth, only rolled section shall be used.

Minimum Sizes of steel elements

The flange width of purlins supporting light weight concrete slab shall not be less than 65 mm.. Width of steel rolled section connected to other member shall be at least 50 mm. The depth of beams for platform of all structures shall not be less than 125 mm.

Slenderness and Depth Ratio





The slenderness ratio of main members in tension, compression or bending shall be in accordance with IS: 800 (Latest Revision).

The following limiting ratios of depth to span shall be considered as a general guide.

a)	Truss	1 / 10
b)	Rolled beams and girders for Ordinary floors and rafters	1 / 24
c)	Supporting floor beams for vibrating Machinery / equipment	1 / 15
d)	Roof purlins and girts	1 / 45
e)	Gable columns	1 / 30

Expansion joints

Longitudinal and transverse expansion joints shall be provided in buildings and structures in accordance with IS: 800 (Latest).

Miscellaneous Criteria

DI gutters and DI down-pipes with gutter outlets having grating cover shall be provided to carry rain water from roofs of buildings to the drainage system at ground level. All gutters shall be designed as walkable (with provisions of handrails) with 600 mm sole width.

Edges of floors, gangways, stairs and landings shall be provided with safety hand railings. All hand railings shall be of tubular hand railings with vertical post, top rail and mid rail made up with tubes.

Connection by permanent bolts to structural elements subject to vibration shall be provided with lock nuts.

Chequered plates, shall not be considered as structural members for transferring horizontal loads.

Design drawings shall contain Section-wise Bill of Quantity etc .Necessary number of prints of drawings and documents; as per contract shall be submitted for approval.

The slopes of bracings, lacings for columns, diagonal members of trusses, bridges, girders etc shall be kept preferably in the range of 35 to 50 degrees.

Structural schematic general arrangement with plans at various levels, elevations along each row and axes, sections, considered loads and load diagrams with location etc. and Structural design drawings with BOQ and Table of members containing design forces along with design calculations





shall be submitted for Purchaser's/Consultant's approval. STAAD Pro file along with Editable excel sheets with active formulae to be submitted. However the approval shall be limited to checking of overall dimensions, general stability of system, effective load transfer and deflection limits etc. The approval shall not relieve the contractor of his responsibility of correctness in design, adequacy of connections, accuracy etc.

Shear force at the column base shall be resisted either by shear keys shop-welded to the underside of column base plates or by welding base plate to inserts provided in foundation.

The level of underside of column base shall be so chosen such that the complete anchor table lies below the finished floor level, thus keeping the shop floor free from projections of anchor tables.

Minimum thickness of base plate for columns at ground level shall be 25 mm (at other levels 16 mm) and minimum thickness of washer plate at any level shall be 0.8 times of Base Plate thickness.

All Built-up columns shall be provided with nominal stiffeners to maintain orthogonal & torsional rigidity, at a spacing not exceeding 1500 mm centre to centre

Roof Structures

- a) Roof shall have suitable slope (1:5, i.e. 1 Vertical: 5 Horizontal, unless otherwise specified) to meet technological as well as rainwater drainage requirements.
- b) Roof drainage system shall be designed for maximum precipitation for 5 minutes based on local meteorological data. In the absence of meteorological data, precipitation of 2 mm per minute may be considered for designing drainage system. A factor of safety of 1.3 shall be kept in the design.
- c) Poking holes with cover shall be provided in the down-pipes at suitable intervals as well as at accessible levels, to clean the down-pipes.



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VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: III

**SPECIFIC DESIGN REQUIREMENTS
[ARCHITECTURE]**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: III
Specific Design Requirements
[Architecture]



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VOLUME: II-B

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**SPECIFIC DESIGN REQUIREMENTS
[ARCHITECTURE]**

1.00.00 SCOPE OF ARCHITECTURAL WORKS INCLUDING SANITARY AND PLUMBING

1.01.00 Scope

The architectural services shall cover finishing work of electrical building, starting from brick work, partition walls, roof protection, finishing of walls, floors and false ceiling, cladding, as required potable water system, service water, Plumbing and sanitation etc. as required for functional requirement.

The bidder offer shall cover the complete requirements as per the best prevailing practices keeping in view the statutory and functional requirements of plants & facilities and providing enough space & access for operation, use & maintenance and to complete satisfaction of the owner.

2.00.00 DESIGN REQUIREMENTS

2.01.00 Codes and Standards

The latest revision of Indian codes and standards are applicable. Unless otherwise stated the latest editions / revision of all related and applicable Indian codes and standards (including IRCs as applicable) along with addendums / amendments, if any, shall be followed. In case the specific Indian Codes and standards are not available, accepted International Codes / standards shall be used.

- National Building Code-2016
- TAC/LPA norms
- Local Fire regulations

2.02.00 Architectural Concepts

The building shall be architecturally treated in such a way so as to be in complete harmony with the main plant, surrounding structures and environment. Local architectural characters may be judiciously





imbibed. The building shall be designed initiating an architectural control common to all buildings. The architectural control shall be clearly spelt out in terms of scale, man & form.

Overall colour scheme of the building shall be designed judiciously and in a comprehensive manner taking into account the mass and void of buildings, its facade, equipment, exposed structural elements, and other service elements.

Overall emphasis shall be on developing an eco- friendly architecture, merging with the nature with its own sustainable energy management systems.

The scheme shall be conceptually finalized in totality including that of equipment so that the proper co-ordination with other agencies can be taken up at appropriate time.

2.03.00 Architectural Design

- a) Natural light shall be used to the maximum extent especially in the form of north light/skylight. For adequate light and ventilation, National Building Code recommendation shall be followed. However all windows of the building shall have minimum 1.0m sill height and bottom of lintel height shall be minimum 2.5 m from finished floor level and minimum door height shall be 2.5m.
- b) Entrance canopies, sunshade (projections, recesses) over openable windows and door openings on exterior facades shall be provided.
- c) The building shall be architecturally designed to meet the National Building Code.
- d) All architectural drawings shall be prepared under responsibility of an Architect. The Architect should be registered under Council of Architecture (COA).
- e) A comprehensive interior design scheme shall be conceived with the intention of projecting a definite theme and aesthetic appearance to inside working environment. It shall take into account the multidisciplinary engineering activities involving power plant technology and architectural & civil engineering for a smooth control hierarchy and man machine interface.
- f) Rain-water pipes or sanitary pipes shall not be visible from outside. Provision of pipe ducts shall be made to ensure pipe routing.





- g) Minimum 2.1m high headroom clearance has to be maintained at every part of the building including staircases. Vertical Head room clearance shall be maintained as per industry factories Act.
- h) Where false ceiling is to be provided, provision of human access has to be made to maintain the HVAC, Electrical and other service lines above false ceiling.

2.04.00 **Description of Electrical Building**

The building shall be as per description stated elsewhere in this Civil/Structural Specification. Architectural concepts of structure shall offer its own identity and will be aesthetically blended to give pleasing appearance maintaining harmony of the plant complex. Functional needs of building shall be maintained. This Building can be located either inside or outside the Chimney shell based on the functional and operational requirements of Electrical / C&I

3.00.00 **ARCHITECTURAL REQUIREMENTS**

3.01.00 **Roof Insulation and Ventilation**

The roof of building shall be provided under deck insulated as per specification given elsewhere in this document. The roof housing manpower and precious equipment's/instruments and AC rooms exposed to heat environment shall be provided with underdeck insulation with false ceiling.

3.02.00 **Roof Waterproofing**

Roof water proofing treatment shall be as follows:

After curing of the concrete, the roofs of building shall be provided with 3 layers, first being minimum 1.5mm thick elastomeric membrane waterproofing treatment coating with $\geq 500\%$ elongation confirming to ASTM C836 applied by a spray/brush/roller in two coats, secondly 120-150 GSM geotextile (non-woven polyester) shall be provided over the Elastomeric coating over which screed concrete (of M20 with 12mm blue metal chips) shall be laid and finally the wearing course. 1.5mm thick Elastomeric membrane shall be laid as per manufacturer's specification. Run off gradient shall be given a minimum of 1 in 100. Gradient shall comprise screed concrete M20 using 12.5 mm or below coarse aggregate and waterproofing treatment as per IS:2645, mixed with polypropylene fibres. Over the screed concrete wearing course treatment shall be provided as below:

A wearing course shall consist of pressed clay tiles of size 230x230x18 mm





minimum laid in waterproofing compound mixed cement mortar (1:3) and sealing of joints using sealing compound.

3.03.00 Partition Wall

All intermediate walls shall be full brick thick wall in 1:5 cement sand mortar. Half brick thick wall in 1:4 cement : sand mortar with 2 nos. 6 mm dia rod in every fourth layer shall be provided. For long walls intermediate RCC pillars and RCC horizontal tie shall be provided. . Full glazed partition in powder coated aluminium frame shall be provided for operator's cubicles for clear view of the operating equipment and in Control room area.

3.04.00 Plastering

Exterior & rough side of interior brick wall	20mm thick minimum sand faced plaster with 1:4 cement-sand mortar in two layers.
Interior wall	12 mm thick with 1:4 cement-sand mortar
Ceiling	10 mm thick with 1:3 cement-sand mortar shall be provided to all exposed ceilings.

3.05.00 False Ceiling

Stove-enamelled Aluminium false ceiling, similar or equal to LUXALON with either lineal panel system or aluminium tile/plank system for control rooms and other important areas, with suspension system as per manufacturer's details shall be used.

Under deck insulation is to be provided in areas of as per HVAC requirement.

The false ceiling work shall take care of all illumination, fire detection & fighting, HVAC and all other service requirement. False ceiling shall be provided with 25 mm thick insulation of resin bonded mineral wool conforming to IS: 8183 over the false ceiling panels. Wherever under-deck insulation is required, the insulation shall be as per specification mentioned elsewhere in the specification, and shall be glued to the roof.

3.06.00 Doors

- Factory made hollow metal (steel) flush doors with pressed steel frame shall be provided in general area.
- At main entrance of the building Rolling steel shutter shall be used where frequent use is not envisaged and large openings-9.0 Sqm and above- are required. Rolling shutters shall be electrically operated.
- Special areas like control rooms and other special area shall be





provided with minimum 15 micron pre-coated i.e. colour powder coated aluminium glazed partitions with air lock facilities having two sets of doors and preferably double door systems.

- d) Doors shall be provided at appropriate location to prevent dust ingress from outside.
- e) Wooden panel doors with teakwood frame shall be provided for toilet entrance and toilet internal doors shall be solid core FRP.
- f) Weather stripping shall be provided to all outside doors as well as air conditioned areas and all other doors where dust-free environment is required.

3.07.00 **Windows & Ventilators**

Full glazed windows and ventilators shall be powder coated and UV protected aluminium window frame with 6 mm thick clear float glass and 5.5 mm thick clear wired glass where required from safety point of view. All windows and ventilators shall meet the requirement of industrial windows and Ventilators. Glazing between AC and Non AC areas shall be double insulated glass. Aluminium sections shall be of heavy duty and from reputed and approved manufacturer. The window area shall be so decided as to allow adequate natural ventilation and light.

Aluminium safety grills shall be provided for all windows.

Note: Member sizes of Aluminium Glazed doors and windows/ventilators shall be designed by the manufacturer and to be submitted for approval by the Bidder before execution.

3.08.00 **Landscaping**

Not applicable under this package.

3.09.00 **Facilities in Buildings**

Adequate toilet and drinking water facilities shall be provided for personnel working in the building. The building shall have toilet facilities both for Gents and Ladies and physically challenged persons. Number of toilet fixtures shall be adequate for the occupancy as per National Building Code.

However minimum 1 EWC and 1 IWC with cistern, 1 washbasin with mirror, towel rail, soap case, 2 urinal shall be provided in each toilet.

The building shall have drinking water facility connected through potable water with water cooler.

Provisions should be kept for barrier free environment for physically challenged persons like ramps in 1 in 12 slope, , toilets, etc. The main entrances of the building shall be provided with ramp.





Pantry provision should be kept for the areas which have office space, control room or the spaces which will be 24 hours manned.

3.10.00 **Potable Water System and Service water Plumbing**

This system shall be connected to the drinking water and service water systems, the scheme for which is indicated elsewhere in this specification.

Water outlets shall be provided for an instantaneous flow rate of approximately 7 Cu.M/Hr. (25 GPM).

System will satisfy state and local plumbing codes. Following I.S. Codes for the system shall be followed:

- a) IS-2065: Code of Practice for water supply in buildings.
- b) IS-1172: Code of basic requirements for water supply, drainage and sanitation.
- c) IS-1200: Laying of water and sewer lines including appurtenant items.
(Pt. XVI)
- d) IS-1239 Specification for mild steel tubes and mild steel tubular and other wrought steel pipe fittings. (10 mm to 15 mm nominal diameter).
- e) IS-3589: Specification for electrically welded steel pipes for water, gas and sewage (220 mm to 2000 mm nominal diameter).

Potable water shall be supplied to basins, water coolers, showers and other plumbing fixtures. Soil and waste piping shall drain through traps to the plant sanitary sewer system.

Service water shall be supplied to water closets, urinals, sinks, and other plumbing fixtures.

3.11.00 **Roof Drainage Systems**

The system shall be provided for removal of water from roof surface to avoid damage to the roof structure and shall consist of the following:

- a) Roof Drain Heads
- b) Rain Water Down comers
- c) Gully pits

IS-1742 code of practice for building drainage shall be followed for this





purpose.

Adequate numbers of rainwater drains heads shall be provided for roof areas as per standard norms for roof area.

System will be designed to handle rainfall at a rate as specified elsewhere in this specification and in accordance with stipulations of IS-1742.

Any roof more than 8.0 metres above grade shall have access from within the building for cleaning of roof drains.

Roof drains will conduct water to storm sewers. No rain water pipes shall be exposed to outside view.

All the drains including plinth protection drains are RCC under this package.

3.12.00 **Glazing & Glazed Partition**

- a) Glazing in Control room between A.C. and non-A.C. areas shall be insulating glass consisting of two 6 mm thick toughened float glass sheet hermetically sealed and separated by 12 mm gap for thermal insulation. Clear glass shall be provided where clear view is required. In other areas tinted glass may be provided.
- b) 6 mm thick ground glass shall be provided for toilets.
- c) Glazing between two A.C. areas shall be with 6 mm thick clear float glass.
- d) All glazing shall be in aluminium frame having 15-micron colour powder coated.
- e) 5.5mm thick. Wired glass shall be used for windows / ventilators at higher level for safety.
- f) For glazed aluminium door, 8.0mm thick clear float glass with or without etching is to be provided

3.14.00 **Sealant**

Silicon sealant around external doors and windows / Polysulphide sealant with polystyrene filler board shall be used in all expansion joints exposed to weather. All joints around exterior doors, windows, etc. shall be sealed for proper water- lightness.

3.15.00 **Damp Proof Course**





50 mm thick (1:1.5:3) concrete with 2% waterproofing admixture or as per manufacturer's recommendation to be provided.

3.16.00 Plinth Protection

Minimum 1000 mm wide and minimum 100 mm thick P.C.C. M 35 plinth protection along building periphery shall be provided with surface drain of required size and slope, to suit storm water quantity, shall be provided. The plinth protection shall be laid over prepared sub-grade and base formed with two layers of locally available laterite/broken stone. Each layer shall have a pre-compacted thickness of 150 mm and consolidated to 115mm. Thus the total thickness becomes 230mm.

3.18.00 Painting

Exterior Masonry Surface : Buildings shall be finished with waterproof External Quality Acrylic Emulsion Paint over plaster (two finishing coats over one coat of primer). Granular textured paint may also be combined along with External Quality Acrylic Emulsion Paint to form suitable pattern on building façade.

Exterior Steel Work : For all external steel structures under civil scope : A primer coat of Zinc Ethyl silicate of 50-60 micron + Under coat of Epoxy Glass Flake(High Build) of 100-110 micron + Two finish coats of Aliphatic Polyurethane(TiO₂) rutile of 50-60 micron each shall be applied

All Woodwork : Synthetic paint two coats over a coat of primer.

All Internal Steel Work : For all internal steel structures under civil scope : A primer coat of Zinc Ethyl silicate of 50-60 micron + Under coat of Epoxy Glass Flake(High Build) of 100-110 micron + Two finish coats of Aliphatic Polyurethane(TiO₂) rutile of 50-60 micron each shall be applied

All Interior wall surfaces with ceiling : Acrylic emulsion paint two coats over one coat of primer over 3 mm wall putty.





3.19.00 **Miscellaneous Work**

- a) Window grill shall be generally powder coated aluminium grill shall be provided.
- b) Anti-termite treatment shall be given to columns pits, foundations, and trenches, below floor as per IS: 6313.
- c) Suitable arrangement of floor drain with trap shall be provided in floor where spillage of water or floor washing will occur.
- d) Doors, windows and rolling shutter in the building shall have sunshade either recessed in the wall or projected out. Projection of sunshade shall be 750 mm for door and 600 mm for windows. Projections for Rolling shutter shall be 1000mm. Where doors and windows are side by side, 750 wide continuous sunshades shall be provided.
- e) Roof access: roofs shall be accessible through proper staircase. Where staircase cannot be provided at least cage ladder shall be provided. Roof access stairs may be open outdoor type. Cage ladder height shall not be more than 6.0m at a stretch. One rest platform shall be given at every 6.0M height of the cage ladder if the ladder height is more than 6.0 m.
- f) Window sill: All window sill height shall be measured from finished floor level.
- g) Lintel height: All lintel height shall be measured from finished floor level.
- h) Parapet height: The roof shall have minimum 1000mm high parapet wall. Parapet wall shall be of RCC and shall be of 125mm thickness.
- i) Internal wall height: Wall height between AC and Non AC areas as well as between two AC areas, shall be full height up to bottom of roof slab or bottom of beam.
- j) False ceiling height: Unless specifically mentioned the false ceiling height shall be 3.m within rooms and 2.7m-3.0m at corridors outside the rooms.
- k) Dado/Skirting height: Unless specifically mentioned the skirting height shall be 150mm from finished floor level and dado height shall be 100mm higher than the door opening height for toilets and kitchen / pantry.





- l) Walkways wherever required shall be of heavy duty 75 mm (minimum) thick anti-skid interlocking concrete paver blocks of approved design and top colour.

3.20.00 **Watch Towers**

Not applicable under this scope of work.

3.21.00 **Sanitary Drainage System**

- a) Diameter of Soil Pipe and Wastewater Pipe outside the building and vertical / horizontal stack connected with 8 fixtures shall not be less than 150 mm.
- b) Drainage pipes shall be UPVC Type-B pipes as per IS: 13592-1992 (amended to 1995) for above ground level and DI pipes for below ground level.
- c) IS: 1742 - Code of Practice for building drainage & IS: 5329 - Code of Practice for sanitary pipe work above ground for buildings should be followed.
- d) If not specified the minimum gradients of soil and drainage pipe line shall be as follows:
- I. 100 mm nominal dia : 1 in 35
 - II. 150 mm nominal dia : 1 in 65
 - III. 230 mm nominal dia : 1 in 120
 - IV. 300 mm nominal dia : 1 in 200
- e) Floor drain should have 'P' or 'S' trap connection as required.
- f) Pipe to pipe should be connected in 45° or 135° both vertically and horizontally.
- g) For cleaning purpose during maintenance, Floor Cleanout and Wall Cleanout should be provided for horizontal run and vertical run of the pipes.
- h) In no case soil pipe shall be connected to waste pipe.
- i) In vertical stack proper venting system with anti-siphonage vent pipes should be provided for all Water Closets.
- j) Drop slab of minimum 450mm depth shall be provided for the toilets where technically and aesthetically required.
- k) All plumbing and water supply fittings & fixtures, rain water drainage of





plants of any building/premises/open area within the Battery limits of this package are in the scope of this contract.

All the sewerage shall be collected and the same shall be interconnected to the Main Plant Sewer System at the nearby RCC manhole

4.00.00 DESIGN DATA FOR ARCHITECTURAL WORKS

1. Brick works – internal and external : 230 mm thick fly ash brick wall with 1:5 Cement- Sand mortar. All non-load bearing Brick work as mentioned in this document shall be with Fly Ash Bricks unless noted otherwise.

Fly ash bricks (cement bonded) shall be locally made. Bricks shall have smooth rectangular faces with sharp and square corners. Bricks shall be machine moulded and shall be made from the admixture of suitable good quality of fly ash, sand and cement as per the composition mentioned below:

FLY ASH :	50-60%
SAND :	32-40%
CEMENT :	8-12%

The fly ash bricks will be as per latest relevant IS code. The bricks will be of dimension as per standard clay brick, suitable for making 230mm thick full brick wall, 115mm thick half brick wall and 75mm thick minor partition walls, as applicable, as per drawing/specification/BOQ. A maximum tolerance of (+/-) 2mm shall be allowed as the manufacturing tolerance. The bricks shall have frog of 100 mm in length 40 mm in width and 10 to 20 mm deep of one of its flat sides.





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The bricks when tested in accordance with the procedure laid down in IS 3495 (part 2): 1992 after immersion in cold water for 24 hrs., water absorption shall be within 13-15% by weight. Similarly, the porosity of the fly ash bricks shall be within 12-20%. The bricks shall have a minimum crushing strength of 75 Kg/CmSq.

Chamber burnt clay bricks shall be used for any load bearing brickwork and for cladding in case of non-availability of Fly ash bricks, subject to the approval of NTPL.

- | | | | |
|----|-----------------------|---|---|
| 2. | Half brick thick wall | : | 1:4 cement: Sand mortar with 2 nos. 6 mm dia M.S. rod in every fourth layer. |
| 3. | One third brick wall | : | 1:3 cement: sand mortar with 2 nos. 6 mm dia M.S. rod at every alternate layer. |
| 4. | Damp proof course | : | 40mm thick 1:1.5:3 Concrete with a 2% admixture of water proofing compound or as per manufacturer's recommendation. |
| 5. | Plaster: | | |
| | Exterior & rough side | : | 20 mm thick with 1:4 cement-sand of interior brick wall mortar in two layers except where special finish provided. |
| | Interior | : | 12 mm thick with 1:4 cement-sand mortar |
| | Ceiling | : | 10 mm thick with 1:3 cement-sand mortar (chicken wire mesh shall be provided at the junctions between RCC-BW |





etc before applying
Plastering.

6. White Cement Putty Punning : 3 mm thick punning to be provided to all areas receiving acrylic emulsion or Acrylic Distemper paint.

7. False Ceiling :

Aluminium pre-painted stove enamelled finish false ceiling, either lineal panel system or aluminium tile/plank system.

a) PANELS

Panels to be manufactured from pre-painted, stove enamelled, alloy EN-AW-5050 or equivalent (according to EN 1396 and ECCA).

Panels are to be coupled in longitudinal direction by means of panel splices.

Optionally the flange with 3 x 7 ventilation holes can be used to achieve a ventilated ceiling.

b) SUSPENSION

Rows of 0.5 Fe/0.95 Aluminium roll formed carriers shall be installed about 1200mm centre on centre by means of adjustable suspensions about a distance of 1200mm, centre on centre. Carriers will be joined by means of carrier splices. Carriers provided with prongs to hold panels in a standard module of 100mm.

c) PERIMETER PROFILES

- Clip-on U-profile, 28.6x12.5 x20 mm, made of 0.35 thick aluminium
- Wall L-profile, 29.2x19.4 mm, made of 0.5 mm thick aluminium
- Wall L-profile, 45x18.5 mm, made of 0.8 mm thick aluminium
- Wall W-profile, 45x21x21x18.5 mm, made of 0.8 mm thick aluminium





d) PERFORATIONS

Manufacturer shall supply panels with following perforation specifications:

- \varnothing 1.0 mm, Δ 2 mm with 23% open area
- \varnothing 2.0 mm, Δ 5 mm with 16% open area

Perforated panels to have a nominal plain border along the longitudinal panel direction to assure a maximum flatness and product stability:

- 84C panel, 1 mm perforated to have a plain border of 7 mm
- 84C panel, 2 mm perforated to have a plain border of 6 mm

e) ACOUSTICS

Manufacturer shall supply acoustic non-woven tissue, thickness 0.2 mm factory applied inside the panels. Alternatively the installer can place individual PE wrapped mineral wool pads.

f) COATING

The coating will consist of a tough and durable polyester finish in nominal thickness of 20 microns, applied in a continuous coil-coating process ensuring uniform coating and absolute adhesion.

g) INSTALLATION

All materials shall be installed by the approved applicator/erector of the manufacturer under supervision of the authorized representative of the manufacturer.

8. Floor finish:

- a. Generally finish to utility areas shall be 50 mm thick heavy-duty granolithic flooring with metallic hardener on concrete slab.

The heavy-duty overlay shall be ready-to-use, metallic aggregates based powder after application of epoxy based bonding agent of two components, solvent less epoxy resin based. It shall be formulated to meet the requirement of ASTM C881 Type 2, Grade 2, and Class B & C. The Bonding agent shall exhibit minimum open time of 6 hours and shall exceed the tensile strength of concrete in terms of its adhesive bond





strength. The Floor topping product shall be high strength with compressive strength of 80 MPa at 28 days; flexural strength exceeding 8 MPa at 28 days. The product shall be capable of resisting metal crawler chassis and shall have abrasive wear less than 0.15 mg/cycle on H22 wheel, ASTM C501 test method. The product shall have adhesive bond strength in excess of 1.5 MPa when tested as per ASTM D4541. Curing of the layer to be done with non-degrading membrane forming curing & sealing compound shall be acrylic resin based formulation. The product shall comply with ASTM C 309 Class B. The product shall exhibit water loss not more than 0.55 kg/m² in 72 hours when tested as per ASTM C156. The product shall form non-degrading abrasion resistance film which shall also exhibit capability as primer for subsequent protective coatings or bituminous overlays.

- b) For special areas like control room, offices etc. shall have 10 mm thick non-skid fully vitrified tiles of minimum size 600 mm x 600 mm (overall 50 mm thick) laid in pattern.

- c) Chemical resistant floor (if required)

For battery room, battery charger room etc. the areas handling corrosive liquids, overall 50 mm thick Chemical resistant vitrified tiles flooring with 20mm thick tiles with silica based epoxy mortar shall be used. Chemical resistant vitrified tiles with silica based epoxy mortar up to 2.1M height from finished floor level shall be used as dado. Acid and Alkali resistant paint shall be applied up to the ceiling level above Acid and Alkali resistant tiles dado. Ceiling shall also be painted with Acid & Alkali resistant paint.

- d) Wet area flooring

All areas of toilet, including W.C and urinal shall have antiskid vitrified ceramic tiles floor. Dado shall be of glazed tiles of minimum 5/6 mm thickness up to 100 mm higher than lintel level starting from finish floor level.

- e) Floor/staircase and the areas prone to slippage due to oil spillage etc. shall be provided with non-skid floor finish.

- f) For MCC and Switchgear rooms flexible electric insulated PVC synthetic sheet as per IS: 15652 2006 shall be applied in front of equipment.

9. Doors & windows The building shall be provided with minimum 15 micron pre-coated i.e. colour powder coated aluminium





glazed partitions with air lock facilities having two sets of doors and preferably double door systems.

- a. In general area shall have hollow metal steel door with or without vision lite
- b. Doors of W.C. and shower shall be hard core FRP door.
- c. Full glazed windows and ventilators shall be powder coated and UV protected aluminium window frame with 6 mm thick (depending on the size of panel) clear float glass and 6 mm thick clear wired/laminated glass where required from safety point of view. All windows and ventilators shall meet the requirement of industrial windows and Ventilators. Glazing between AC and Non AC areas shall be Double insulated glass. Aluminium sections shall be of heavy duty and from reputed and approved manufacturer. Windows and ventilators shall be fabricated and painted by the reputed fabricators at their own fabrication shop. Windows shall be glazed aluminium windows conforming to IS: 1949 & IS: 1948.

10. Rolling Shutters:

Rolling shutters as per IS: 6248 with electrically operating arrangement according to size shall be provided in buildings to facilitate handling and transportation of equipment for large openings from 9.0 sqm and above. Wherever truck entry is envisaged, minimum size of rolling shutter size shall not be less than 3.5m (W) x 4.0m (H).

The curtains of rolling shutter will be of interlocking scrolls made of hot rolled double dipped galvanised steel lath section of 18swg tested mild steel strips at 75mm rolling centres, locked with galvanised malleable iron clips. The bottom lath will be coupled to a locked plated fabricated from 3mm thick galvanised steel plate and security riveted with stiffening angles.

11. Glazing:

- a. Glazing for windows in general shall be minimum 6 mm clear float glass and as mentioned elsewhere in this document.
- b. Glazing in Control room between A/C & non-A/C area shall be with double glazed insulating glass consisting of 2 nos. 6 mm clear toughened float glass with 12 mm air gap in between, hermetically sealed.
- c. Minimum 8.0 mm thick toughened float glass as specified





below shall be provided in doors, partitions.

d. 24mm thick insulated double glazing having 6mm thick tinted heat- reflecting type outer float glass and 6mm thick plain inner float glass with 12mm air gap & hermetically sealed shall be mounted on powder coated aluminium frame suitable for structural glazing system. Quality of glass is given below.

- 6mm thick Glass quality shall be toughened hard coated CVD on line process glass with Low -E coated in surface # 2 having (Light Transmission 82%, Visible light Reflectance- 10% & inside - 11%, Total Solar Energy Transmittance - 66% Reflectance-10% UV transmission - 49%, Solar Heat Gain Coefficient - 0.70 Shading Coefficient - 0.81 ,U - Factor Air 2.77 W/m²k , Sound Insulation - 31db outer lite.
- 6 mm thick toughened Blue low E hard coated CVD on line process glass with Low -E coated in surface # 2 having (Light Transmission 35%, Reflectance 13%outside & inside - 30 %, Total Solar Energy Transmittance - 19%, Reflection - 9%, UV - 9 %, Solar Heat Gain Coefficient - 0.29 Shading Coefficient - 0.33,U -Factor Air - 1.9 W/m²k, Sound Insulation - 33db outer lite (# 2 surface) Glass with a combination of 6 mm thick toughen Optifloat clear 6mm glass inner lite (# 3 Surface) Now the two sheets of glass will be separated by an aluminium spacer leaving an air gap of 12.7 mm thick and sealed with the weather proof sealant.

12. Roof waterproofing :

After curing of the concrete, the roofs of building shall be provided with 3 layers, first being minimum 1.5mm thick elastomeric membrane waterproofing treatment coating with $\geq 500\%$ elongation confirming to ASTM C836 applied by a spray/brush/roller in two coats, secondly 120-150 GSM geotextile (non-woven polyester) shall be provided over the Elastomeric coating over which screed concrete (of M20 with 12mm blue metal chips) shall be laid and finally the wearing course. 1.5mm thick Elastomeric membrane shall be laid as per manufacturer's specification. Run off gradient shall be given a minimum of 1 in 100. Gradient shall comprise screed concrete M20 using 12.5 mm or below coarse aggregate and waterproofing treatment as per IS:2645, mixed with polypropylene fibres. Over the screed concrete wearing course treatment shall be provided as below:

A wearing course shall consist of pressed clay tiles of size 230x230x18 mm minimum laid in waterproofing compound mixed cement mortar (1:3) and sealing of joints using sealing





compound.

All around on the roof, at the parapet wall junction, an angular fillet 50mm x 50mm shall be trowel applied in cement-sand mortar (cement, sand mortar shall be supplied by you) in 1:3 proportion. A latex based bonding agent should be added (10% by weight of cement) and also a glass cloth must be inserted around the junctions while the angle fillet is being constructed.

For vertical surfaces (Parapet)

Surface preparation, minor cleaning works, removal of loose concrete, laitance, dust particles, etc. and filling cracks with polymer modified mortar using latex based bonding agent. Removal of algae if present is to be done. Providing and applying a water based acrylic primer over the entire surface of the parapet walls (2 part primer : 1 part water). Providing and applying 2 coats of a high performance elastomeric coating, composed of acrylic emulsion polymers having anti-carbonation properties, UV resistant and DFT of 110 microns, conforming to ASTM-D412-02, D1202-97, D 4587, D 4645, BS-EN 12390 over the exterior wall surface.

Note: Waterproofing materials should be applied by the manufacturer in-house application wing or authorised applicators only under supervision of manufacturer's authorised person.

- b) For efficient disposal of rainwater, the run off gradient for the roof shall not be less than 1:100. The top surface of finished roof shall be such as to allow quick drainage of rainwater.
- c) DI pipes of 150mm dia minimum conforming to relevant BIS Code shall be provided to drain off rainwater from the roof.. The numbers and size of down comers shall be governed by IS: 1742 and IS: 2527.

13. Painting:

- a) External masonry surfaces of all buildings shall be finished with External Quality waterproof Acrylic Emulsion paint over plaster.
- b) Acrylic internal emulsion paint of shall be provided in all interior surfaces of the building.
- c) Battery room and all other areas coming in contact with acid/alkali or other corrosive liquid (if required) shall be painted with chemical resistant paint.





14. Water Supply and Sanitation :

- a) HDPE roof water tank of adequate capacity depending on the number of users for 8 hours storage shall be provided for each building.
- b) Galvanized MS Pipe of medium class shall be used for internal piping work for potable water supply. All water supply pipes inside the Non plant buildings are to be laid as concealed type.
- c) DI pipes shall be used for sanitary work below ground.
- d) UPVC pipes with proper sealing shall be used for sanitary work above ground level.
- e) Drainage pipes shall be UPVC Type-B pipes as per IS: 13592-1992 (amended to 1995) for above ground and DI pipe for below ground.
- f) Toilet shall contain following best quality fittings/porcelain fixtures in adequate numbers as per National Building Code. In toilets primarily meant for workers an additional squatting type WC shall be provided. Minimum one exclusive toilet facilities for handicapped shall be provided
 - Water closet – Indian & European type.
 - Large flat back urinal with marble slab divider.
 - Wash basin – Oval shaped Counter-top (Granite) wash basin.
 - Minimum 500 mm long Chromium plated towel rail.
 - Chromium plated liquid soap holder.
 - Chromium plated toilet paper roll holder.
 - Robe hooks
 - Minimum 750 mm high square edge 6 mm thick float glass mirror of adequate width to match toilet layout and interior décor, shall be mounted on PVC sheet.
 - Drinking fountains in adequate numbers.

The exact number of fittings and fixtures, brand, colour etc.





shall, however be finalized during detail engineering stage and same shall be of Owner's choice and Approval. However minimum 1 EWC and 1 IWC with cistern, 1 washbasin with mirror, towel rail, soap case, 2 urinal shall be provided in each toilet.

Note Toilets for physically-challenged persons shall have adequate grab bars, barrier-free access and appropriate fittings and fixtures.

15. Under-Deck Insulation

- a. Insulation material shall be Closed Cell Elastomeric Nitrile Rubber
- b. Density of Material shall be between 40 to 60 Kg/m³
- c. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 W/m²K at an average temperature of 0°C
- d. The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category. Water vapour permeability shall not exceed 0.017 Perm inch (2.48 x 10⁻¹⁴ Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor 'μ' value should be minimum 7000.
- e. Under-deck insulation shall be provided for all AC areas having roof exposed to sun/floor exposed to heat atmosphere.
- f. Thickness:
 - For Concrete Slab: 25 mm thick sheet is used
 - For Corrugated or metal ceiling: 32 mm thick sheet

16. Sealant:

1. Polysulphide Elastomeric joint sealant shall be, two-component, high performance polysulfide formulation having weathering resistance to ultraviolet ray property. The product shall exhibit **shore 'A' hardness of 25** and have **movement accommodation factor of 25%**. The sealant must comply with the performance specifications as laid in **BS: 4254 and ASTM C 920**. All the joints must be primed using compatible primer for the substrate from the equal or similar to MASTERFLEX PRIMER range of BASF. Sealant application shall be carried out, strictly in accordance with Manufacturer's recommendations.





2. Polyurethane based single component joint sealant materials based upon polyurethane resins. They have been formulated with different modulus of elasticity 0.25-0.45 N/mm² and Shore 'A' hardness of 15-30 which makes them suitable for slightly different applications. The product shall exhibit elongation at break 600 % and recovery of 80%.

17. Statutory rules:

- a) Design shall be complied with all applicable statutory rules pertaining to Factories Act as applicable for the State, Rules of Tariff Advisory Committee (TAC) / Loss Prevention Association (LPA), and Water Act for pollution control etc.
- b) Provision of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkway, minimum 500 mm wide, along the crane girder at crane girder level on both sides, comfortable approach to EOT crane cabin, fire escape, locker room for workmen, pantry, toilets, rest rooms etc.
- c) Provision for fireproof doors, number of staircases, fire separation walls, encasing of structural members (in fire prone areas) etc. Shall be made according to the recommendation of Loss Prevention Association of India / Tariff Advisory Committee.
- d) Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.



Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

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SECTION: I
PART: C
SUB SECTION: IV
GUIDELINE
FOR
MASONRY AND ALLIED WORK



Development Consultants Pvt. Ltd.

Volume: II-B
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Masonry and Allied Work



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**GUIDELINE
FOR
MASONRY AND ALLIED WORK**

1.00.00 **SCOPE**

This specification covers furnishing, providing, installation, repairing, finishing, curing, protection, maintenance and handing over of masonry and allied works for use in structures and locations covered under the scope of the Contract.

2.00.00 **INSTALLATION**

2.01.00 **Brick Edging**

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

2.02.00 **Masonry**

2.02.01 **General**

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

2.02.02 **Mortar**

Mix for mortar shall be specified..

For cement sand mortar cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency.





Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

2.02.03 **Brick Masonry**

Bricks shall be soaked in water before use for a period for the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. For brick work in half brick wall, bricks shall be laid in stretcher bond. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar. At the joint of brick masonry with RCC column/beam/wall, the mortar shall be with rich grade to avoid shear cracks.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing. The inside face of the brick work shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow space are left inside the joints. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

2.02.04 **Exposed Brickwork**

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by especially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of windowsills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule and string. All brickwork shall be cleaned at the end of days work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from





routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

2.02.05 Reinforced Brickworks

Reinforcements shall be as specified.. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. Columns or welded to steel stanchions.

2.02.06 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and as specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

2.02.07 Moldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with carborandum stone.

2.02.08 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

2.02.09 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

2.03.10 Encasing of Structural Steel

This shall be done by building masonry work, around flanges, webs etc. of steel members and filling the gap between steel and masonry by minimum 12 mm thick rich mortar. Encased members shall be wrapped with minimum 18G chicken wire mesh when shown on drawings or instructed by the Engineer, before plastering work.

The minimum lap in chicken wire mesh shall be 50 mm.





2.03.11 **Damp Proof Course**

Unless otherwise specified Damp-proof course shall be 50 mm or as per schedule thick 'artificial stone' in proportion 1:1-1/2:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

3.00.00 **I.S. CODES**

Some of the important relevant codes for this section are: -

- | | | |
|-----------|---|---|
| IS : 1127 | : | Recommendations for dimensions and workmanship of natural building stones for masonry work. |
| IS : 2185 | : | Code Practice for hollow concrete block. |
| IS : 1597 | : | Code of Practice for Construction of stone Masonry. |
| IS : 1609 | : | Code of Practice for laying Damp-proof treatment Using bitumen felts. |
| IS : 2212 | : | Code of Practice for Brickwork. |
| IS : 2250 | : | Code of Practice for preparation and use of Masonry Mortar. |
| IS : 5134 | : | Bitumen Impregnated Paper & Board. |





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**GUIDELINE
FOR
FINISH TO MASONRY AND CONCRETE**



Development Consultants Pvt. Ltd.

**Volume: II-B
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Finish to Masonry and Concrete**



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**GUIDELINE
FOR
FINISH TO MASONRY AND CONCRETE**

1.00.00 **SCOPE**

This Specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Bidder shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.00 **INSTALLATION**

2.01.00 **Scaffolding**

For all exposed brick work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purpose shall be filled and made good before plastering.

Note : In case of special type of brick work, scaffolding shall be got approved from Engineer-in-Charge in advance.

2.01.01 **Preparation of Surface**





The cement plaster shall be 6 mm, 10mm, 12mm, 15mm, 18mm or 20mm as specified.

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.02.00 **Plastering**

2.02.01 **Mortar**

Mortar for plastering shall be as specified in the specifications.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 **Application of Plaster**

Ceiling plaster shall be completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true





surface, plaster about 15 x 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working or over working the float shall be avoided.

All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not to nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. Horizontal joints in the plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Thickness

Where the thickness required as 20mm, the average thickness of the plaster shall not be less than 20mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15mm while in case of stone work the minimum thickness over the bushings shall be not less than 12mm.

Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitable protected from all damages at the Bidder's expense by such means as the Engineer-in-Charge may approve. The dates on which





the plastering is done legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

2.02.03

Finish

The plaster shall be finished to a true and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surface shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

Precaution

Any cracks which appear in the surface and all portions which sounds hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

- i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6mm drawn with any suitable method with the wall while the plaster is green.
- ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150mm wide chicken wire mesh should be fixed with U nails 150mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall not be made separately.
- iii) Due to faulty construction, if the plaster thickness increases more than 20 mm, the Bidder shall provide chicken mesh to hold the plaster, at his own cost.

Cement Plaster with a Floating coat of Neat Cement

The cement plaster shall be 6mm, 10, 12, 15, 18mm or 20mm thick, finished with a floating coat of neat cement, as described in the specification.

Specifications for this item of work shall be same as described above except for the additional floating coat which shall be carried out as below.

When plaster has been brought to a true surface with the wooden straight edge, it shall be uniformly treated over its entire area with a pest of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quality of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in





no case later than half an hour of adding water to the plaster mix. The rest of the specifications described in above shall apply.

18mm/20 mm Cement Plaster (Two Coat Work)

The specification for scaffolding and preparation of surface shall be as described above.

Mortar

The mix and type of the aggregate specified in the description of item shall be used for the respective coats. Generally the mix of the finishing coat unless otherwise described in the item.

Generally coarse sand shall be used for the under coat and fine sand for the finishing coat , unless otherwise specified for external work and under coat work, the fine aggregate shall conform to grading zone IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

Application

The plaster shall be applied in two coats i.e. 12 mm under coat and then 6/8mm finishing coat and shall have an average total thickness of not less than 18/20mm.

12mm under coat

This shall be applied as specified earlier except that when the plaster has been brought to a true surface a wooden straight edge and the surface shall be left rough and furrowed 2 mm deep with a scratching tool diagonally both ways, to form key for the finishing coat. The surface shall be kept wet till the finishing coat is applied.

6/8 mm finishing coat

The finishing coat shall be applied after the under coat has sufficiently set but not dried and in any case within 48 hours and finished in the manner specified earlier.

Specifications for curing, Finishing and Precautions shall be as describe earlier.

6/10 mm Cement Plaster on Cement Concrete and Reinforced Cement Concrete Work

Scaffolding

Stage scaffolding shall be provided for the work. This shall be independent of the walls.

Preparation of Surface





Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed with wire brushes. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacing of not more than 5 cm. Centers, the pock being made not less than 3mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned off all oil, grease etc. and well wetted before the plaster is applied.

Mortars

Mortar of the specified mix using the types of sand described in the item shall be used.

Application

To ensure even thickness and true surface, gauges of plaster 15 x 15 cm. shall be first applied at more than 1.5m intervals in both directions to serve as guides for the plastering. Surface of these gauged areas shall be truly in the plane of the finished plaster surface. The plaster shall be then be applied in a uniform surface to a thickness slightly more than the specified thickness and shall then be brought to true and even surface by working a wooden straight edge reaching across the gauges. Finally the surface shall be finished true with a trowel or with wooden float to give a smooth or sandy granular texture as required. Excess troweling or over working of the floats shall be avoided. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Plastering of ceiling shall not be commenced until the slab above has been finished and centering has been removed. In the case of ceiling of roof slabs, plaster shall be commenced until the terrace work has been completed. These precautions are necessary in order that the ceiling plaster is not disturbed by the vibrations set up in the above operations.

Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

Thickness

The average thickness of plaster shall not be less than 6 mm. The minimum thickness over any portion of the surface shall not be less than 5mm.

Curing

The specification as stated earlier





Precautions

The specification as stated earlier

2.02.04 Other Finish

Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. Per Sq.M. or as per schedule and shall be rubbed smooth with a trowel.

2.03.00 Pointing to Masonry

All joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be





applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.05.00 White Cement Putty Punning

Plastered surfaces, where specified shall be finished with White Cement Putty punning. The material shall be from approved manufacturers and approved by the Engineer. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 sq.m. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

PROPERTY

1. Tensile Adhesion Strength (N/MM ²) @ 28 Days	> 1.0
2. Compressive Strength (N/MM ²) @ 28 Days	> 9.0
3. Setting Time (Minutes) - Initial	=> 100
Final	=< 500
4. Water Absorption Coefficient - Kg/M ² .H ^{1/2}	< 1.0
5. Water Capillary Absorption (ML) @ 24 Hrs.	0.8
6. Water Retentivity %	> 98

Surface Preparation

All loosely adhering materials on the plastered wall surface is to be removed with the help of emery stone, putty blade or wire brush and clean water. The substrate should be cleaned, free from dust, grease and loose materials. Dry and absorbent surface should be moistened with sufficient quantity of clean water.

Mixing

White cement putty should be mixed slowly with 30-35% of clean water to form a paste. Mixing is to be continued for 10-15 minutes to form a uniform paste.

Application method





First coat shall be applied on well moistened plastered wall surface from bottom to upward direction uniformly with putty blade. After drying of first coat the surface shall be rubbed gently with wet sponge or putty blade to remove loose particles. Surface shall be allowed 3 hours to dry before applying the second coat. After complete drying of second coat, loose particles shall be removed by gently rubbing the surface with wet sponge or putty blade. After mixing the putty should be utilized within 2 hours. Total thickness of coats shall not be more than 1.5mm or as per manufacturer specifications.

2.06.00 **Cement Water Proofing Compound**

It shall be used for cement mortar for plastering or concrete work.

Water Proofing Compound

Integral cement water proofing compound conforming to IS 2645 and of approved brand and manufacturer, enlisted by the Engineer-in-Charge from time to time shall be used.

The Bidder shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added. It shall be measured by weight.

3.00.00 **ACCEPTANCE CRITERIA**

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 **I. S. CODE**

Important relevant code for this Section:

- a) IS : 1661 : Code of practice for cement and cement-lime plaster finish on walls and ceilings.
- b) IS : 4101 : Code of practice for external facings and veneers.
- c) IS : 1200 (Pt-XII): Method of Measurements of Building and Civil Engineering Works: Part: XII-Plastering and Pointing





Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: VI

**GUIDELINE
FOR
METAL DOORS, WINDOWS, VENTILATORS, LOUVRES,
ETC.**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: VI
Metal Doors, Windows, Ventilators, Louvres,
Curtain Wall, Structural Glazing, etc.



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**Volume: II-B
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**VOLUME: II-B
SECTION: I**

PART: C

SUB SECTION: VI

**GUIDELINE
FOR
METAL DOORS, WINDOWS, VENTILATORS, LOUVRES ETC.**

1.00.00 SCOPE

The work in general shall consist of supplying and erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. as shown on drawings with all materials complete including supply of glass and glazing. The scope of work shall also include the assembly at site and erection of all doors, windows, louvers, glazed partitions, etc. for which fabricated materials. Supplying and fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified in drawing and schedules.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions, etc. shall be extruded sections conforming to IS: 733 and 1285 for chemical composition and mechanical properties. The stainless steel screws shall be grade AISI 304. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified in "Schedule of Fixtures" and the best quality from approved list of manufacturers shall only be used. The successful bidder shall specifically state the list of manufacturer's materials he proposes to use. "Schedule of Fixtures" is for the purpose of stating the minimum requirement and improper alignment or faulty operation due to





inadequate strength of hardware or fixture shall entirely be the Bidder's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closers shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated elsewhere in the specification. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance requirements & endurance test stated in IS: 3564 Appendix- A.

The Bidder shall submit **three** samples of each type of hardware to the Engineer for approval. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Bidder towards the end for incorporation in the job.

The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall be as per IS: 1081 and/or as approved by the Engineer.

2.02.00 **Fabrication**

2.02.01 **Steel Doors, Windows, Ventilators, Louvers, etc.**

a) **Door Frames**

Frames shall be fabricated from 16 G sheets. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place.

b) **Double Plate Flush Door Shutters**

Door shutters shall be 45 mm thick, completely flush design and shall comprised of two outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centers.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have





proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting stile edges beveled or rebated. Where shown on drawing or called for in the schedule of items the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push-plates and other surface hardware where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown in drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections with profiles shown in drawing and suitable for fixing 6 mm glass. Louvres blades shall be V or Z shaped and made out of 16 G sheets.

c) **Single Sheet Door Shutters**

Single sheet doors shall be made from best quality 18 G mild steel sheets and shall present a flush surface on the outside. The inside shall be stiffened with semi-tubular edge and central stiffening rail, which shall convey the lock and other furniture. The frames shall be made from best quality 16 G mild steel sheets.

Wherever required as shown on drawings, provisions for fixing glass panes, louvers, etc. shall be made.

The manufacturing shall be done as specified in "Double Plate Flush Door Shutters".

2.02.02 **Aluminium Door, Windows and Frames**

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors, frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 0.6 mm thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent coating shall be applied to the sections before shipment from the factory.

Where required factory made evenly baked powder coated coloured aluminium extruded sections shall be used. DFT shall not be less than 0.8 mils. Colour shall be as per Colour Schedule or as per instruction of the Engineer-in-Charge.

All work shall be fitted and shop assembled to a first class job and ready for erection. Shop joints shall be made to hairlines and then welded or braced by





such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.06.00 **Shop Coat or Paint**

The shop paint for steel doors, windows, etc. shall be best zinc ethyl silicate primer paint from approved manufacturer conforming to IS 2074. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Portions of aluminium frame which come in contact with masonry construction shall before shipment from workshop be protected with a heavy coat of alkali paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc ethyl silicate primer.

2.07.00 **Handling & Storage of Fabricated Material**

All metal doors, windows, etc. shall be packed and crated properly before dispatch to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Bidder shall satisfy himself that the items supplied are upto the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows, etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminum products by rust, mortar, etc.

2.08.00 **Assembly & Erection at Site**

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081 and as shown on drawings. The Bidder shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places as shown on drawing keeping proper lines and levels, and in approved workman like





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manner to give trouble free and leak-proof installations. The installation shall be done according to the instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Bidder shall take every precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Bidder and made good again as per original, after installation

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Bidder shall bring to the site the mastic cement in original sealed containers of manufacturer and shall apply it as per the instructions. For all frames supplied by either the Owner or the Bidder mastic shall be supplied by the Bidder and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metre from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For Fabricated Items

- a) Overall dimensions shall be within ± 1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 1.5 mm.
- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on a true planes, free from warp or buckle.





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- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures.
- h) Provisions for hardware and fixtures to be installed at site.
- l) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.
- l) Exposed aluminium surfaces shall be free from scratches, stains and discolouration. Anodised surfaces shall present a uniform and pleasing look.

3.02.00

For Installed Items

- a) Installations shall be at correct location, elevation and in general on a true vertical plane.
- b) Fixing details shall be strictly as shown on drawings.
- c) Assembly of composite units shall be strictly as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.
- d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.
- e) All openable section shall operate smoothly without jamming.
- f) Locks, fasteners, etc. shall engage positively. Keys shall be non-interchangeable.
- g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- h) Aluminium doors, windows, etc. shall be free from scratches stain or discolouration.





4.00.00 **INFORMATION TO BE SUBMITTED**

4.01.00 **After Award**

- a) Names of manufacturers for doors, windows, etc.
- b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.
- c) Before starting fabrication of all metal doors, windows, etc. the Bidder shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.
- d) He shall submit a programme of work to be done for the approval of the Engineer.
- e) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of bulk supply and returned to the Bidder towards the end for final incorporation in the job.

5.00.00 **I.S. CODES**

Following are some of the important I.S. Codes as relevant to this section :

Steel doors, windows and ventilators	-	IS : 1038
Steel windows for industrial buildings	-	IS : 1361
Aluminium doors windows and ventilators	-	IS : 1948
Aluminium windows for industrial buildings	-	IS : 1949
Steel doorframes	-	IS : 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows, And ventilators.	-	IS : 1081
Wrought Aluminium and Aluminium Alloys, Bars, Rods and Sections (For General Engineer Purposes) – Specification	-	IS : 733
Wrought Aluminium and Aluminium Alloy sheet, and strip for General Engineer Purposes - Specification	-	IS : 737





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Wrought Aluminium and Aluminium Alloy, Extruded Round Tube and Hollow sections (For General Engineering Purposes) –Specification	-	IS : 1285
Anodic coating on Aluminium and its Alloys – Specification	-	IS : 1868
Specification for Aluminium equal leg angles	-	IS : 3908
Specification for Aluminium unequal leg angles	-	IS : 3909
Dimensions for wrought Aluminium and Aluminium Alloys bars, rods and sections.	-	IS : 3965
Method of testing anodic coating on aluminium and Its alloys	-	IS : 5523
Measurement of coating thickness by Eddy Current Method	-	IS : 6012
Floor springs (Hydraulically regulated) for heavy doors Specifications		IS : 6315
Dimensions of extruded hollow section and tolerances	-	IS : 6477





Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: VII

**GUIDELINE
FOR
ANTI-TERMITE TREATMENT**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: VII
Anti-Termite Treatment



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for
Chimney**

**NLC Tamil Nadu Power Ltd.
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**GUIDELINE
FOR
ANTI-TERMITE TREATMENT**

1.00.00 **SCOPE**

The scope of work is to prevent the subterranean termites from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites while the building is under construction. This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide.

2.00.00 **EXECUTION**

2.01.00 **General**

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

Anti-termite treatment chemical is available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. 19 parts of water shall be added to one part of chemical for achieving 1% concentration.

2.02.00 **Safety Precautions**





Chemical used for anti-termite treatment are insecticides with a persistent action and are highly poisonous. This chemical can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mists or swallowed.

The containers having emulsifiable concentrates shall be clearly labeled and kept securely closed in stores so that children or pet cannot get at them. Storage and mixing of concentrates shall not be done near any fire source or flame. Persons using these chemical shall be warned that absorption through skin is the most likely source of accidental poisoning. Particular care shall be taken to prevent skin contact with concentrates and prolonged exposure to dilute emulsion shall also be avoided. After handling the concentrates or dilute emulsion, workers shall wash themselves with soap and water and wear clean clothing, especially before eating. In the event of severe contamination, clothing shall be removed at once and skin washed with soap and water. If chemical has splashed into the eyes, they shall be flushed with plenty of soap and water and immediate medical attention shall be sought.

Care should be taken in the application of chemicals to see they are not allowed to contaminate wells or springs which serve as source of drinking water.

2.03.00 **Chemicals and Rate of Application**

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals	Concentration by Weight, Percentage
Chlorpyrifos Emulsifiable (20EC) (IS 8944 - 1978)	: 1.0
Heptachlor Emulsifiable (20EC) Concentrate (IS: 6439 - 1978)	: 0.5
Chlordane Emulsifiable (20EC) Concentrate (IS: 2682 - 1984)	: 1.0
Lindane (20 EC) (IS: 632)	: 1.0

2.03.01 **Treatment**

To facilitate proper penetrations of chemical in to the surface to be treated, hand operated pressure pump shall be used. To have proper check for uniform penetration of chemical, graduated containers shall be used. Proper check should be kept so that the specified quantity of chemical is used for the





required area during the operation. Chemical treatment for the eradication and control of sub-terranean termites shall be done as per IS 6313 (Part III).
2.03.02 **Treatment of Column Pits, Wall Trenches and Basement Excavations**

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (up to a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M² of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M² of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.

If there is a concrete or masonry apron around the building, approximately 12mm diameter holes shall be drilled as close as possible to the plinth wall about 300mm apart, deep enough to reach the soil below and the chemical emulsion pumped into these holes to sock the soil below at the rate of 2.25 litres per linear metre.

2.03.03 **Treatment of Top Surface of Plinth Filling**

Holes 50 cm to 75 cm deep at 100 cm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M² of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

2.03.04 **Treatment of Soil Surrounding Pipes, Wastes and Conduits**

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 cm and a depth of 75 cm at the point where they enter the building.

2.03.05 **Treatment of Expansion Joints**

These shall receive special attention and shall be treated in a manner approved by the Engineer.

2.03.06 **Treatment at Junction of the Wall and the Floor**

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface.

A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level





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300 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation.

3.00.00 I.S. CODE

Relevant code applicable for this Specification.

IS: 6313 (Part-II) 1981	:	Code of Practice of Anti-Termite Measures in Buildings (pre-constructional)
IS : 632	:	Gamma-BHC (Lindane) emulsifiable Concentrates
IS : 8944 – 1978	:	Chlorpyrifos emulsifiable concentrates
IS : 8963	:	Chlorpyrifos- Technical specifications
IS : 6439 – 1978	:	Heptachlor Emulsifiable
IS : 2682 – 1984	:	Chlordane Emulsifiable

Pre-constructional chemical treatment measures.





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**GUIDELINE
FOR
ROLLING STEEL SHUTTERS, GRILLS
AND COLLAPSIBLE DOORS**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: VIII
Rolling Steel Shutters, Grills and
Collapsible Doors



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**GUIDELINE
FOR
ROLLING STEEL SHUTTERS, GRILLS
AND COLLAPSIBLE DOORS**

1.00.00 SCOPE

This specification covers the design, supply of materials, fabrication, delivery and erection of Rolling Shutters with motor drive operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION

2.01.00 Components

- a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick of CR grade for shutters upto 4.5 M wide and not less than 2.25 mm thick of CR grade for shutters 5.5 M wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.
- b) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats
- c) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.
- d) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.M
- e) Shafts shall be of steel pipe of sufficient size to carry the torsional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.
- f) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.





- g) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. .
- h) Power unit shall be suitable for 3 phase, 50 cycle, 400 volt A.C. power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

- i) Operating chains shall be of tested quality, heavily galvanised and with all ends rounded to assure smooth operation and hand protection.
- j) Reduction gears shall be high strength gray cast iron, machine moulded from machine out patterns.

2.02.00 **Power Operated Shutters**

These shall be operable from a push button station conveniently located beside the door or as shown on drawings. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for in , externally mounted shutters shall be operated by control mechanism located inside the building.

2.03.00 **Rolling Shutters**

Rolling shutters shall conform to IS 6248. These shall include necessary locking arrangement and handles etc. These shall be suitably fixing in the position as specified i.e. outside or inside on or below lintel or between jambs of the opening. The door shall be either push and pull type/Mechanical and electrically operated

Shutter : The shutter be built up of inter locking lath section formed from cold rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90mm for the shutters up to 3.5m width and not less than 2.25 mm thick of CR grade for shutters 5.5 M wide and above. Shutters above 9 metres width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure of 100 kg/sq.m. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure.





Each lath section shall be continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centers. Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking in the lath section at both ends preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

Spring : The spring shall be coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454 - Part I.

Roller and Brackets : The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS 1161 to carry the torsional load with a maximum deflection of $1/360^{\text{th}}$ of span. For shutter up to 6 metre width and height not exceeding 5 metre, steel pipes of 50mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters up to clear height of 3.5 metre. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5m and up to 6.5 m. The suspension shaft clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall connected by means of pretensioned helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 mtr, the cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning two row ball bearings with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15 mm and at least 4 number flats running throughout length of roller shall be provided.

In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a purion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

Guide Channel : The width of guide channel shall be 25mm the minimum depth of guide channels shall be as follows :

Clear width of shutter	Depth of guide channel
Up to 3.5 m	65mm
3.5m up to 8m	75mm
8m and above	100mm

The gap between the two legs of the guide channels shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent rattling of the shutter due to wind.





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Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the wall or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide channels shall be attached to the jambs, plumb and true either in the overlapping fashion or embedded in grooves, depending on the method of fixing.

Cover : Top cover shall be mild steel sheets not less than 0.90mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Power unit : Power unit shall be suitable for 3 phases, 50 cycles, 400 volt A.C. power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building. It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS 6248.

Operating chains shall be of tested quality, heavily galvanised and with all ends rounded to assure smooth operation and hand protection.

Reduction gears shall be high strength gray cast iron, machine moulded from machine out patterns.

Fixing : The arrangement for fixing in different situations in the opening shall be as per IS 6248.

Brackets shall be fixed on the lintel or under the lintel as specified with rawl plugs and screws bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and brackets shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in workmen like manner that the operation of the shutter is easy and smooth.





2.04.00 **Shop Coat**

Shutters shall be painted with one coat of zinc ethyl silicate primer. the finish coat shall be as per SS III/part C/sec I/vol II B

2.05.00 **Erection**

Door shall be installed by the manufacturer or his authorised representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.

3.00.00 **ACCEPTANCE CRITERIA**

3.01.00 **Shop Inspection**

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

3.02.00 **Field Inspection**

After installing the shutters, the successful Bidder shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault-free performance.

4.00.00 **I.S. CODE**

IS : 6248 - Metal rolling shutters and rolling grills.





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**GUIDELINE
FOR
GLASS AND GLAZING**



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Glass and Glazing



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GUIDELINE

FOR

GLASS AND GLAZING

1.00.00 **SCOPE**

The work in general shall consist of supplying and fixing all glass and glazing including all clips, putty, mastic cement etc wherever required as shown on drawings and specifications, supply of metal glazing beads and neoprene gaskets shall be included in this scope.

2.00.00 **INSTALLATION**

2.01.00 **General**

The Bidder shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions from approved manufacturer, shall have uniform refractive index and free from flaws, specks and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials

- a) Clear glass shall be float glass and should be approved by the Engineer-in-Charge and shall be at least 6 mm thick for windows and for doors & glazed partitions shall be minimum 8mm thick or as indicated in doors' and windows schedule. It shall be clear, float transparent toughened and free from cracks subject to allowable defects. The float glass shall conform to the IS 14900. The thickness of float glass shall be measured with micrometers or a calliper which is graduated to 0.01 mm or with a measuring instrument having an equivalent capacity.
- b) Wired glass of 5.5mm thick minimum shall be provided for all buildings except office rooms, control rooms and A/c rooms.
- c) Obscure glass shall have a cast surface in one side.





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- d) 24mm thick insulated double glazing having 6mm thick tinted heat-reflecting type float glass on outer side and 6mm thick clear float glass on inner side with 12mm air gap & hermetically sealed shall be mounted on 15 micron coloured anodised aluminium frame suitable for structural glazing system.
- e) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing. Quick setting putty glass is used where it shall be non-setting type.
- f) The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer-in-Charge shall only be used. The Bidder shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in-Charge.

The EPDM gasket shall meet the requirements as given in Table below :

SL. No.	Description	Standard Follow	Specification
1	Tensile strength kg.f/cm ²	ASTM-D 412	70 Min.
2	Elongation at break %	ASTM-D 412	250 Min.
3	Modulus 100% Kgf/cm ²	ASTM-D 412	22 Min.
4	Compression set % at 0° CC 22 Hrs.	ASTM-D 395	50 Max.
5	Ozone resistance	ASTM-D 1149	No visible cracks

Quality of glass

- a) All glass shall comply with ECBC 2007 requirements.
- b) Single glass panels shall have properties like –
VLT = 35 to 50%, external reflection=6 to 15%, internal reflection=8 to 15%, solar factor=0.36 to 0.43, U value=2.8 to 3.0 W/sqm K to be provided.
- c) Double glazed panels with glass having properties like-
VLT = 30 to 45%, external reflection=8 to 20%, internal reflection=15 to 30%, solar factor=0.26 to 0.29, U value=1.8 to 1.9 W/sqm K. shall be provided.





2.02.00 Reflective Glass

Definitions

- i) **Shading Coefficient** : The shading coefficient is the ratio of total solar transmittance to the transmittance through 3.2 mm (1/8") clear glass. Windows with low shading coefficient values improve comfort for building, lower the total cooling load of the building and help smooth out of the difference in cooling loads between perimeter & core zones.
- ii) **Luminous Efficiency Constant (Ke)** indicates a windows relative performance in rejection solar heat-while transmitting day light. It is the ratio of the visible transmittance to the shading coefficient; clear glass which lets in roughly equal amounts of visible light and solar near-infrared energy has a Ke close to 1.0. The solar radiation contains about 50% invisible near-infrared & ultra violet light. Therefore, a perfectly selective glazing, which would all allow visible light pass through while blocking all of the invisible near-infrared & ultraviolet light, would have Ke of about 2.0.
- iii) **Resistance to Heat Conduction (R-value)** : It is a measure of resistance to heat flow that occurs because of temperature difference between the two sides of the windows. The inverse of R-value is termed as U-value.

2.03.00 Glazing, Setting and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Bidder.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing clips shall be provided per glass pan, except for large panes where six or more clips shall be used as per Engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by the Bidder.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where moulding or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Necessary glazing clips, putty, mastic cement etc. shall be supplied by the Bidder. The Bidder shall be responsible for damage of glass , during handling, transportation, fixing etc.





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After completion of glazing work, the Bidder shall remove all dirt stains, excess putty etc. clean the glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the Bidder's own cost.

3.00.00 ACCEPTANCE CRITERIA

- a) All installation shall be free from cracked, broken or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by EPDM gaskets to give a leak proof installation.
- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.00.00 IS CODES

Following are some of the important I.S.Codes relevant to this Section;

- IS : 3548 - Code of practice for glazing in building.
- IS : 1083 - Code of practice for fixing and glazing metal doors, windows and ventilators.
- IS : 14900 - Transparent Float glass - Specifications.





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**GUIDELINE
FOR
FLOOR FINISHES AND ALLIED WORKS**



Development Consultants Pvt. Ltd.

Volume: II-B
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Floor Finishes and Allied Works



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**GUIDELINE
FOR
FLOOR FINISHES AND ALLIED WORKS**

1.00.00 **SCOPE**

This specification covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes and allied items of work as listed below:

a) **In Situ Finishes**

- Metallic Hardener like "Ironite" or equivalent finish

b) **Tiled Finishes**

- Pressed Ceramic Tile Flooring (Vitrified Tile Flooring)
- Pressed Ceramic Tiles In Skirting And Dado
- Chemical Resistant Tiled Finish
- Anti-Static PVC Flooring

1.01.00 **Base**

The base to receive the finish is covered under other relevant specifications.

1.02.00 **Sequence**

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Bidder for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.





2.00.00 **INSTALLATION**

2.00.01 **Special Materials**

Basic materials are covered under Specification "Properties Storage and Handling of Common Building Materials". Special materials required for individual finishing items are specified under respective items. In general, all such materials shall be as per relevant I.S. Codes where available. In all cases these materials shall be of the best quality available indigenously, unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialised manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.00.02 **Workmanship**

Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires that the Bidder shall get the finishing items installed by the manufacturer.

2.00.03 **Preparation of the Base Surface**

The surface to be treated shall be thoroughly examined by the Bidder. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush and detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification under individual item.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be done dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.



2.01.00 **In Situ Finishes**

2.01.01 **Cement Concrete Flooring with Metallic Hardener Topping**

Wherever floors are required to withstand heavy wear and tear, use of floor hardener shall be avoided as far as possible by using richer mixes of concrete, unless the use of a metallic hardener is justified on the basis of cost.

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is "Green".

a) **Thickness**

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth (top layer of 50mm thick floor finish).

b) **Material**

The hardening compound shall be of approved quality consisting of uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials. When desired by the engineer, actual samples shall be tested.

c) **Mix**

The top layer shall consist of 12mm thick layer of mix 1: 2 (1 cement: 2 stone aggregate 6mm nominal size) by volume or as otherwise specified with which metallic hardening compound is mixed in the ratio of 1:4 (1 metallic concrete hardener: 4 cement) by weight or as per manufacturer's specification relevant to medium/heavy duty floor. Metallic hardener shall be dry mixed thoroughly with cement on a clean dry pacca platform. This dry mixture shall be mixed with stone aggregate 6mm nominal size or as otherwise specified in the ratio of 1:2 (1 cement :2 stone aggregate) and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete.

d) **Laying**

The concrete floor shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The forms, if any shall remain sufficiently projecting to take the finish. The surface shall be roughened by wire brush as soon as possible.

The mixture so obtained shall be laid in 12mm thickness, on cement concrete floor while the concrete under bed is still very "green" within 2 to 4 hours of it's laying. The topping shall be laid true to provide a





uniform and even surface without trowel marks, pin holes etc. It shall be firmly pressed into the bottom concrete so as to have good bond with it. Just when the initial set starts the surface shall be finished smoothed with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.02.00 **Tiled Finish**

These shall include vitrified tiles, over already laid and matured base of concrete by means of an underbed or an adhesive layer.

2.02.01 **Pressed Ceramic Tile Flooring (Vitrified Tile Flooring)**

Tiles shall conform to Table 12 of IS and the joint thickness in flooring shall not be more than 1mm.

a) **Materials : Vitrified Tiles**

The tiles shall be of approved make and shall generally conform to the approved standards. They shall be flat and true to shape, free from cracks, crazing spots, chipped edges and corners. Unless otherwise specified, the nominal sizes of tiles shall be as under:

The tiles shall be square or rectangular of nominal sizes such as: 600 x 600 mm; 900 x 900 mm or as per drawings or as directed by the Engineer-in-Charge. Thickness shall be as per recommendations of the approved manufacturers. However the floor tile thickness shall not be less than 10mm and the overall thickness of the floor finishing shall be 50mm.

Technical specifications of the tiles shall be generally conforming to the following standards:

Technical Specifications For Vitrified Tiles

No.	Property	Expected Standards
1	Deviation in length	(+/-) 0.6%
2	Straightness of sides	(+/-) 0.5%
3	Rectangularity	(+/-) 0.6%
4	Surface flatness	(+/-) 0.5%
5	Water absorption	< 0.50%
6	Mohs. Hardness	> 6





7	Flexural strength	> 27 N / mm ²
8	Abrasion resistance	< 204 mm ²
9	Skid resistance (friction coefficient)	> 0.4
10	Glossiness Min.	85% reflection

The tiles shall conform to the relevant standards in all respects. Samples of tiles shall be got approved from the Engineer-in-charge before bulk procurement for incorporation in the work.

b) **Preparation of Surface for Flooring**

Following procedure shall be followed :

- **Sub grade**

Concrete or RCC slab or side brick wall / or plastered surfaces on which tiles are to be laid shall be cleaned, wetted and mopped as specified for terrazzo tile flooring.

- **Mortar and bedding**

Cement mortar for bedding shall be prepared of mix 1:4 or as specified. to a consistent paste and shall conform to the specification for materials; preparations etc. as specified under cement mortar. The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in preparation of the mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed the base shall be cleaned off all dirt, scum or laitance and loose materials and well wetted without forming any pools of water on the surface. The mortar of specified proportion and thickness shall then be evenly and smoothly spread over the base by use of screed battens to proper level or slope.

Once the mix is prepared, no further water be added and the same shall be used within one hour of adding water.

Apply on an average 20 mm thick bedding of mortar over an area of 1 sqm at a time over surface of the area for laying tiles, in proper level and allowed to harden sufficiently to offer a fairly good cushion for the tiles to set.

c) **Laying Of Tiles for Flooring**





The tiling work shall be done as per the pattern shown in the drawing or as directed by the Engineer-in-Charge. As a general practice laying of tiles shall be commenced from the centre of the area and advanced towards the walls. Cut tiles, if any, shall be laid along wall with necessary border pattern as shown / directed by the Engineer-in-Charge. Tiling work shall be completed by pressing tiles firmly into place along the wall /floor. White cement slurry to the back of the tile to be applied to ensure proper and full bedding. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles. Tiles, which are fixed on the flooring adjoining the wall, shall be so arranged that the surface on the round edge tiles shall correspond to the skirting or dado. Press gently the tile with wooden mallet for even adherence at the back of the tile. Do not use an iron hammer or some heavy material to press the tile. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight line. Unless otherwise specified, joint-less tiling shall be done butting the tiles with each other. If joint is specified, the same shall not exceed 1.00 mm. in width. The joint shall be grouted with white / matching colour cement slurry. After fixing the tiles, finally in an even plane or slope, the flooring shall be covered with wet sand and allowed undisturbed for 14 days.

d) **Fixing Tiles for Dado & Skirting**

The fixing of tiles on wall surfaces shall be done only after completing fixing of the tiles on the floor. Following procedure shall be followed:

DAE / DCSEM: 102: SPN-CVL

The back of tiles shall be cleaned off and covered with layer of approved adhesive like BAL-ENDURA or equivalent with proper trowelling as per manufacturers recommendations.

The edges of the tiles shall be smeared with the adhesive and fixed on the wall one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly fixed in level with the adjoining tiles. There shall be no hollows on the back or in joints. Unless otherwise specified, joint-less tiling shall be done butting the tiles with each other. If joint is specified, the same shall not exceed 1.00 mm. in width. The joint shall be grouted with approved adhesive. The joints shall be kept in straight line or as per the approved pattern.

While fixing tiles in dado / skirting work, care shall be taken to break the joints vertically. The top line shall be touched up neatly with the rest of the plaster above. If doors, windows or other openings are located within the dado area, the corners, sills, jambs etc. shall be provided with true right angles without any specials.



The fixing shall be done from bottom of wall to upward without any hollows in the bed of joints. Each tile shall be as close as possible to one adjoining. All tiles faces shall be in one vertical plane.

e) **Grouting Of Joints In Floor / Skirting / Dado**

The joints, if specified, shall be cleaned off and all dust and loose particles removed. Joints shall then be filled with approved adhesive like BAL-ENDURA or equivalent grouts.

After finishing the grouting process, after 15 minute, wipe off excess grout with a damp sponge and polish the tiles with a soft & dry cloth for a clean surface. The Finished work shall not sound hollow when tapped with a wooden mallet.

f) **Cleaning**

As directed by the Engineer-in-Charge, the tiles shall be cleaned by mild acid (However, Hydrofluoric acid and its derivatives should not be used). After the tiles have been laid in a room or the days fixing work is completed, the surplus cement grout / adhesive that may have come out of the joints shall be cleaned off before it sets. The dado / skirting shall be thoroughly cleaned. In the case of flooring, once the floor has set, the floor shall be carefully washed clean and dried. When drying, the floor shall be covered with oil free dry sawdust. It shall be removed only after completion of the construction work and just before the floor is used.

g) **Cleaning Agents for Vitrified Tiles**

Vitrified tiles are resistant to all chemicals (except hydrofluoric acid and its derivatives), hence commercially available detergents and cleaning agents can also be used for regular maintenance. Any spills and stains must be removed immediately. If left dry they may leave stains, which may be difficult to remove completely.

Cleaning Agents for Vitrified Tiles

Stains

Robin Blue
Marker ink
Pen ink
Methylene blue
Sauce
Cement

Tea
Coffee
Beer
Diesel

Cleaning Agent

Household detergent / Warm water
Turpentine / Acetone / Trichloroethylene
Acetone / Isopropyl alcohol
Isopropyl alcohol / Acetone
Ammonia solution
Turpentine / Acetone / Trichloroethylene
/ Conc. HCL
Hydrochloric acid / Bleaching powder
Sodium hydroxide / Potassium hydroxide
Sodium hydroxide / Potassium hydroxide
Acetone / Petrol





Lab indicator	Acetone / Isopropyl alcohol
Cement and grouting	Hydrochloric acid
Pencil mark	Benzene or Toluene or Xylene
Plaster of Paris (POP)	Ammonium sulphate solution

Stains

Iodine (Tincture iodine)
Hair dye
Paan
Marker pen

Cleaning Agent

Sodium hydroxide / Potassium hydroxide
Per chloric acid
Lemon juice or citric acid
Acetone

2.02.02

Pressed Ceramic Tiles In Skirting And Dado

The tiles shall be approved make and shall generally conform to IS 15622. The tiles shall be pressed ceramic covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze or more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be free from glaze; however, any glaze if unavoidable shall be permissible on only up to 50% of the surface area of edges.

The glaze shall be free from welts, chips, craze specks, crawling or other imperfections detracting from the appearance when viewed from a distance of one metre. The glaze shall be either glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be specified by the Engineer-in-Charge. There may be more than one colour on a tile.

Dimensions and Tolerances

Glazed pressed ceramic tiles shall be made square or rectangular in sizes Table 1, 3, 5, & 7 of IS 15622 give the modular sizes and table 2, 4, 6 & 8 of IS 15622 gives the sizes of non modular tiles. The tiles shall conform to IS 15622 for dimensional tolerance, physical and chemical properties.

Half tiles for use as full tiles shall have dimensions which shall be such as to make the half tiles when joined together (with 1mm joint) match with dimensions of full tiles. Tiles may be manufactured in sizes other than those specified above.

The thickness of the tiles shall be 5 mm or 6 mm or as specified.

The dimensions of fittings associated with the glazed tiles namely cover base, round edge tile, angles corner cups, ridge and legs and capping beds shall be





of the shape and dimensions as required and thickness of fittings shall be the same as the thickness of tiles given above.

Preparation of Surface

The joints shall be raked out to a depth of at least 15mm in masonry walls. In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

Laying

12mm thick plaster of cement mortar 1:3 (1 cement: 3 coarse sand) mix of as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals.

The tiles should be soaked in water, washed clean and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and joined. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd size/cut size of tile shall be adjusted at bottom to take care of slope of the flooring. Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed these shall be cut (swan) to the required size and their edges rubbed smooth. Skirting/ dado shall not project from the finished "surface of wall" by more than the thickness, undulations if any shall be adjusted in wall.

Curing and Finishing

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles. The work shall then be kept wet for 7 days.

After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

2.02.03 Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemical. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures.





Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/Cm². The surface shall be abrasion resistant and durable.

b) **Laying**

The mortar used for setting or for underbed the tiles shall be durable and strong. The grout which shall be to the full depth of tile shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.04 **Anti-Static PVC Flooring**

PVC flooring of 2mm thick should be of approved make & brand with scratch proof, flexible & impregnated polyurethane reinforced (PUR) permanently static conductive Vinyl sheet, consists of impregnated polyurethane homogeneous mixture of PVC, plasticizers, urethane, colour pigments and filler calendared of approved colours and pattern detail. The material should be fixed with synthetic acrylic adhesive after preparing the floor, leveling & smoothing when necessary with suitable putty, as per the design & instruction of the Engineer-in-charge. Electrical resistance should be min R10⁸ ohm as per ESD approval, SP-method 2472. Anti-static sheets should be confirming clean Room Test Class A as per ASTM F 51/100.

3.00.00 **ACCEPTANCE CRITERIA**

The finish shall be checked specially for :

- a) Level, Slope, Plumb as the case may be
- b) Pattern and Symmetry
- c) Alignment of joints, dividing strip etc.
- d) Colour, texture
- e) Surface finish
- f) Thickness of joints
- g) Details at edges, junctions etc.
- h) Performance
- i) Precautions specified for durability





4.00.00 **I.S. CODES**

Important relevant codes for this section:

IS: 777	:	Glazed earthenware tiles
IS: 1196	:	Code of practice for laying bitumen mastic flooring.
IS: 1197	:	Code of practice for laying of rubber floors
IS: 1237	:	Cement concrete flooring tiles
IS: 1443	:	Code of practice for laying and finishing of cement concrete flooring tiles.
IS: 2114	:	Code of practice for laying in situ terrazzo floor.
IS: 3461	:	PVC asbestos floor tiles
IS: 4860	:	Specification for acid resistant bricks
IS: 5518	:	Code of practice for laying of flexible PVC sheet and tile flooring.
IS: 5491	:	Code of practice for laying in situ granolithic floor topping.
IS: 4457	:	Specification for ceramic unglazed vitreous acid resisting tiles
IS: 4441	:	Code of practice for use of silicate type chemical resistant mortars.
IS: 4443	:	Code of practice for use of resin type chemical resistant mortars.
IS: 4832 (part I)	:	Specification for chemical resistant mortar: silicon type.
IS: 4832 (part II)	:	Specification for chemical resistant mortar: resin type.
IS: 4832 (part III)	:	Specification for chemical resistant mortar: sulphur type.
IS: 13753	:	Specification for dust pressed ceramic tiles with water absorption of E>10%
IS: 13755	:	Specification for dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)





Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: XI

**GUIDELINE
FOR
PAINTING, POLISHING ETC.**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: XI
Painting, White Washing & Polishing



**Tender Specification
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**VOLUME: II-B
SECTION: I**

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SUB SECTION: XI

**GUIDELINE
FOR
PAINTING, POLISHING ETC.**

1.00.00 SCOPE

This specification covers painting, polishing etc. of both interior and exterior surfaces on wood work, masonry, masonry surface with white cement putty, concrete plastering, plaster of Paris punning, false ceiling, structural and other miscellaneous steel items, rain water down comer, pipes, and other ferrous and non-ferrous metal items as shown on drawings, or as directed by the Engineer.

Copper, bronze, chromium plate, nickel, stainless steel, aluminium and monel metal shall generally not be painted or finished except if otherwise specified.

The painting Bidder shall inspect the work of others prior to the application of paint. If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the painting Bidder shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing those results.

Before commencing painting, the painting Bidder shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations. Bidder shall keep record of number of coats of painting. Before applying second coat, the Bidder shall obtain prior approval of Engineer in Charge

2.00.00 INSTALLATION

2.01.00 Materials

Materials shall be Grade-1 quality from well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals





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unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint or one shade is obtained from the same manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painter's bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognised manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

Exterior Painting on Wall

Material : The paint shall be (Textured exterior Emulsion paint / Acrylic smooth exterior Emulsion paint / premium acrylic smooth exterior Emulsion paint) of approved brand and manufacture.

This paint shall be brought to the site of work by the Bidder in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The material shall be kept in the joint custody of the Bidder and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface : For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection before painting is commenced.

Application :

Base coat of water proofing cement paint – All specifications in respect of base coat of water proofing cement paint shall be as described before.





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Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with portable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-Charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

The specifications in respect of scaffolding and protective measures shall be as describe before.

3.00.00

PAINTING

Materials

Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Only ready mixed Paint (Exterior grade) as received from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-in-Charge shall be used.

Approved paints, oil or varnishes shall be brought to the site of work by the Bidder in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the Bidder and the Engineer-in-Charge. The empties shall not be removed from the site of the work, till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Commencing Work

Painting shall not be started until the Engineer-in-Charge has inspect the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external





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surface should not be done in adverse weather condition like hail storm and dust storm.

Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.

The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the Paint work being started.

Preparation of Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

Application

Before pouring into smaller containers for use, the Paint shall be stirred thoroughly in its containers, when applying also, the Paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over the Paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, to or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by through ventilation. Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is laid.

No left over Paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.





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No hair marks from the brush or clogging of Paint puddles in the corners of panels, angles of moulding etc. shall be left on the work.

In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no Paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need to be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.

On painting steel work, special care shall be taken while painting over bolts, nuts, rivets overlaps etc.

The additional specifications for primer and other coats of Paints shall be as according to the detailed specifications under the respective headings.

Brushes and Containers

After work, the brushes shall be completely cleaned of Paint and linseed oil by rinsing with turpentine. A brush in which Paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that Paint dose not thicken and also shall be kept safe from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

4.00.00 PAINTING PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES

Primer

The primer for wood work, iron work or plastered surface shall be as specified in the description of item.

Primer for plaster / wood work / Iron & Steel / Aluminium surfaces shall be as specified below.





Table-2

Sl. No	Surfaces	Primer to be used
1.	Wood work (hard and soft wood)	As specified in elsewhere in the specification
2.	Resinour wood and plywood	
3.	(A) Aluminium and light alloys	
4.	(B) Iron, Steel and Galvanized steel Cement/Concrete/RCC/brickwork, Plastered surfaces, non-asbestos surfaces to receive Oil bound distemper or Paint finish.	

The primer shall be ready mixed primer of approved brand and manufacture.

Where primer for wood work is specified to be mixed at site, it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7 kg : 0.7 kg : 1 litre.

Where primer for steel work is specified to be mixed at site, it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8 kg : 1 litre : 1 litre.

The specifications for the base vehicle and thinner for mixed on site primer shall be as follows:

- i) **White Lead** : The white lead shall be pure and free from adulterants like barium sulphate and whiting. It shall confirm to IS 103.
- ii) **Red Lead**: This shall be in powder form and shall be pure and free from adulterants like brick dust etc. It shall confirm to IS 102.
- iii) **Raw Linseed Oil**: Raw linseed oil shall be lightly viscous bit clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30 degree C shall be between 0.923 and 0.928.

Note: The oil shall be mellow and sweet to the taste with very little small. The oil shall be of sufficiently matured quality. Oil turbid or thick, with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall confirm in all respects to IS 75. The oil shall be of approved brand and manufacture.

- iv) **Double Boiled Linseed Oil**: This shall be more viscous than the raw oil, have a deeper colour and specific gravity between 0.931 and 0.945 at a





temperature of 30 degree C. It shall dry with a glossy surface. It shall confirm in all respects to IS 77. The oil shall be of approved brand and manufacture.

Turpentine : Mineral turpentine i.e. petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate product of oleoresin of conifers) shall be used. It shall have no grease or other residue when allowed to evaporate. It shall confirm to IS 533.

All the above materials shall be approved manufacture and brought to site in their original packing in sealed condition.

4.01.00 **Preparation of Surface**

4.01.01. **Wooden Surface :** The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material confirming to IS 345 with same shade as Paint shall be used where specified. The surface treated for knotting shall be dry before paint is applied. After obtaining approval of Engineer-in-Charge for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

4.01.02. **Iron and Steel Surface :** All rust and scales shall be removed by scrapping or by brushing with wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.

If the surface is wet, it shall be dried before priming coat is undertaken.

4.01.03. **Plastered Surface :** The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations shall be filled up with plaster of paris and rubbed smooth.

Application





The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described before.

Treatment on Steel for Aggressive Environment

A second coat of ready mixed zinc ethyl silicate primer may be applied where considered necessary in aggressive environment such as near Industrial Establishment and Coastal regions where the steel members are prone to corrosion. The second coat is to be applied after placing the member in position and just before applying Paint.

5.00.00 **PAINTING RAIN WATER, SOIL, WASTE AND VENT PIPES AND FITTINGS**

The primer shall be prepared on site or shall be of approved brand and manufacture as specified in the item.

Paint shall be anti-corrosive bitumastic Paint, aluminium Paint or other type of Paint as specified

Painting New Surface

Preparation of Surface : The surface shall be prepared for priming coat as described earlier.

Application : The number of coat of painting over the priming coat shall be as stipulate in the description of the item. The application of Paint over priming coat shall be carried out as specified above.

Painting on Old Surface

Preparation of Surface : If the old Paint is firm and sound, it shall be cleaned and grease, smoke etc. The surface shall then be rubbed down with sand paper and dusted. Rusty patches shall be cleaned up and touched with synthetic enamel paint.

If the old Paint is blistered and flaked, it shall be completely removed as described before. Such removal shall be paid for separately and painting shall be treated as on new work.

Application : The specifications for application shall be as described earlier.

6.00.00 **PAINTING WITH WOOD PRESERVATIVE**





Oil type wood preservative of specified quality and approved make, confirming to IS 218 shall be used. Generally, it shall be creosote oil type-I or anthracene oil.

Painting on New Surface

Preparation of Surface : Painting shall be done only when the surface is perfectly dry to permit of good absorption. All dirt, dust or other foreign matter shall be removed from the surface to be painted. All roughness shall be sand papered and cleaned.

Application : The preservative shall be applied liberally with a stout brush and not daubed with rags or cotton waste. It shall be applied with a pencil brush at the joints of the wood work. The first coat shall be allowed at least 24 hours to soak in before the second (the final) coat is applied. The second coat shall be applied in the same manner as the first coat. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

Painting on Old Surface

The work shall be done in the same manner as on new surface except that only one coat shall be done.

7.00.00

COAL TARRING

Coal tar of approved manufacture confirming to IS 290 shall be used. The tar, to every litre of which 200 gm of unslaked lime has been added, shall be heated till it begins to boil. It must then be taken off the fire and kerosene oil added to it slowly at the rate of one part of kerosene oil to six or more parts by volume and stirred thoroughly. The addition of lime is for preventing the tar from running.

Coal Tarring on New Surface

Preparation of Surface : This shall be done as specified in 4.01.00 except that sand papering is not necessary. Where iron work is to be painted it shall be free from scales and rust before painting.

Application : The mixture shall be applied as hot as possible with a brush. The second coat shall be applied only after the first coat has thoroughly dried up. Where possible, the article to be tarred, shall be dipped in the hot mixture for better results. The quantity of tar to be used for the first or second coat shall be not less than 0.16 and 0.12 litre per sqm respectively. Thinning with kerosene oil shall be suitable done to ensure this.

Coal Tarring on Old Surface





The work shall be done in the same manner as specified above (Coal Tarring on New Surface) except that only one coat using 0.12 litre per sqm. area shall be done.

8.00.00

SPRAY PAINTING WITH FLAT WALL PAINT ON NEW SURFACE

The work shall include a priming coat of 'Distemping Primer' or 'Cement Primer' as specified in the description of the item. Flat wall Paint shall normally be applied on walls 12 months after their completions, in which case Distemper primer will suffice. If the walls are to be painted earlier, the primer coat shall consist of cement primer.

The primer and the flat wall Paint shall be of approved brand and manufacture and of the required shade.

Preparation of the Surface : The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

Application

Priming Coat : The specified primer shall be painted or sprayed over the surface in an even and uniform layer.

Painting Coats : When the surface is dry, the spray painting with the wall Paint in uniform and even layers will be done to the required number of coats. Each coat shall be allowed to dry overnight and lightly rubbed with every fine grade of sand paper and loose particles brushed off before the next coat is sprayed.

Spraying should be done only when dry condition prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application. The air pressure shall not be kept too high as otherwise the Paint will fog up and will be wasted.

At the end of the job, the spray gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.





If after the final coat of wall Paints, the surface obtained is not upto the mark, further one or more coats as required shall be given after rubbing down the surface and dusting off all loose particles to obtain a smooth and even finish.

If the primer or wall Paint gets thickened during the application, it shall be thinned suitably with the thinner recommended by the manufacture.

Adequate ventilation shall be provided to disperse spray fumes. Fitments and floor shall be protected from the spray.

9.00.00

SPRAY PAINTING WITH FLAT WALL PAINT ON OLD SURFACE

Where the old Paint is in sound condition, renewal shall be carried out as described below, otherwise the old Paint shall be completely stripped and spray painting shall be carried out as over new work. Such removal shall be paid for separately.

The flat wall Paint shall be of approved brand and manufacture and of required shade.

Preparation of Surface

The surface shall be washed to remove dust and dirt. A mild detergent solution like soap water shall be used for washing and surface shall also be rubbed down lightly with abrasive paper when dry. Any patches appearing on the surface shall first be touched up with a coat of Paint. These shall be allowed to dry and then rubbed down tightly.

Application

The paint shall then be applied with spraying machine in uniform and even layer. A second coat shall be applied if considered necessary by the Engineer-in-Charge but only after the first coat is complete dry and hard.

Spraying should be done only when dry condition prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application. The air pressure shall not be kept too high as otherwise the Paint will fog up and will be wasted. At the end of the job, the spray gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they result in variable spray patterns, runs, sags and uneven coats.

10.00.00

INTERENAL WALL PAINTING WITH Acrylic EMULSION PAINT

These Paints are to be used on internal surfaces except wooden and steel.





Painting on New Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

Application : The number of coats shall be as stipulated in the specification. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Precautions

- a) Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water.

Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.

- b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
- c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
- d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

Painting on Old Surface

Preparation of Surface : This shall be done, generally as specified in 4.01.01 except that the surface before application of Paint shall be flattened well to get the proper flat velvety finish after painting.





Application : The number of coats to be applied shall be as in description of item. The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Except the above the thinning with water shall not normally be required.

11.00.00 PAINTING WITH ACID PROOF PAINT

Acid proof Paint of approved brand and manufacture and of the required shade shall be used.

Preparation of surface and application shall be as specified in earlier clauses for new/old surface as the case may be.

Other details shall be as specified in earlier clauses as far as they applicable

12.00.00 PAINTING WITH ANTI-CORROSIVE BITUMASTIC PAINT

Ready mixed Paint (confirming to IS 158) shall be of approved brand and manufacture. It shall be black, lead free, acid-alkali-heat-water resistant.

Preparation of surface and application shall be as specified in previous clauses for Painting on new or old surfaces as the case may be.

The drying time between consecutive coats, however, shall be not less than 3 hours.

Other details shall be specified in earlier clauses as far as applicable.

13.00.00 FRENCH SPIRIT POLISHING





Pure shellac confirming to IS 16 varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm of shellac to 1 litre of spirit. Suitable pigment shall be added to get the required shade. Ready-made polish confirming to IS 348 can also be used.

Polishing New Surface

Preparation of Surface : The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 Kg of whiting per litre of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

Application : The number of coats of polish to be applied shall be as described in the item.

A pad of wooden cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

Other details shall be as specified in earlier clauses as far as they are applicable.

Polishing Old Surface

Preparation of Surface : If the old polished surface is not much solid it shall be cleaned of grease and dirt by rubbing with turpentine and then rubbed with fine sand paper.

If the old polished surface is much soiled then it will be necessary to remove the entire polish and such removal shall be paid for separately outside the rate of polishing. Further the polishing itself will have to be done like new work and will be paid for as such.

Application : The specifications shall be same as described above and as far as applicable.





Other details shall be as specified in earlier clauses as far as they are applicable.

14.00.00 **EPOXY COATING/PAINTING**

On the clean surface of concrete after properly drying of the following system is to be adopted as per manufacturers specification:

One coat of primer of following proportion to be applied over clean and dried concrete surface by brush application.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 840 - 50 Parts by weight

Over the primer, the uneven surface of concrete should be filled with levelling putty as mentioned above. The cost of putty is included in the item rate without fixing prior limit to consumption of putty. Two top coats of the protective treatment to be applied over the prepared smooth surface in the following proportion.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 830 - 45 Parts by weight

HARDENER BY 850 -15 Parts by weight

SILICA FLOUR - 20 Parts by weight

FLOW CONTROL - 2 Parts by weight
AGENT

Pigment may be added if desired by Engineer. The first top coat is applied over the primer and is left to reach a tack free state. At this stage, the final top coat is applied.

14.01.00 **Protection**

Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipments shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

14.02.00 **Cleaning up**

In addition to provisions in general conditions the Bidder shall, upon completion of painting etc. remove all marks and make good surfaces, where





paint has been spilled, splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

15.00.00 **ACCEPTANCE CRITERIA**

- a) All painted surfaces shall be uniform and pleasing in appearance.
- b) All varnished surfaces shall be of uniform texture and high glossy finish.
- c) The colour, texture etc. shall match exactly with those of approved samples.
- d) All stains, splashes and splatters of paints and varnishes shall be removed from surrounding surfaces.

16.00.00 **I. S. CODE**

Important relevant IS Codes for this Sections are listed below :

- | | | |
|----------------------|---|---|
| IS: 348 | : | Specification for French polish |
| IS: 427 | : | Specification for Distemper, dry colour as required. |
| IS: 428 | : | Specification for Distemper oil emulsion, colour as required. |
| IS: 1477
(I & II) | : | Code of Practice for painting of ferrous metal in buildings. |
| IS: 2338
(I & II) | : | Code of Practice for finishing of wood and wood based materials. |
| IS: 2339 | : | Specification for Aluminium Paints for general purposes in dual containers. |
| IS: 2395 | : | Code of Practice for painting concrete, masonry and plaster surface. |
| IS: 2932 | : | Specification for enamel, synthetic, exterior, type-I. |
| IS: 5410 | : | Specification for cement paint, colour as required. |





Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: XII

**GUIDELINE
FOR
ROOF WATER PROOFING, INSULATION
AND ALLIED WORKS**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: XII
Roof Water Proofing, Insulation & Allied Works



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

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**VOLUME: II-B
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SUB SECTION: XII

**GUIDELINE
FOR
ROOF WATER PROOFING, INSULATION
AND ALLIED WORKS**

1.00.00 SCOPE

This specification covers providing, furnishing, installation, repairing, finishing, curing, testing,, protection, maintenance till handing over of roof water-proofing, insulation and allied work for buildings and at locations covered under the scope of the Contract. Roof water proofing shall be followed as specified in Sub Section III of Vol-IIB Sec-I, Part-C. However the following section gives the methods of waterproofing for general guidance.

2.00.00 INSTALLATION

2.01.00 Before taking up the water proofing work the construction of parapet walls, including finishing should be completed. Similarly, the ancillary items like haunches, khurras, grooves to take the fiber cloth layer, fixing up of all down take pipes, water pipes and electric conduits etc. should be completed and no such work should be allowed on the area to be treated during the progress of water proofing treatment or even later.

2.01.01 There is no necessity of hacking the surface to be treated shall be cleaned including removing the mortar dropping from the surface.

2.01.02 Grading Underbed

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.





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The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25 mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete.

The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.03 The grading plaster shall be average 25mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The same and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.02.00 **Concrete**

The concrete shall be used where the sub-grade is more than average 25mm thick. It shall consist of cement concrete 1:2:4 nominal mix by volume with 12mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable. The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.03.00 **Insulation**

The successful bidder shall furnish specification of insulating materials he proposes to use and the proposed method of laying to the owner for approval. Before bulk supply, the Bidder shall send samples of insulating material to the Engineer, and after approval of the samples, the Bidder shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Bidder shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12mm and it shall be cured for seven days.

2.07.00 **Elastomeric Membrane**

2.07.01 **Primer Coat**

It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush /spray with





airless spray equipment over the prepared bed as an adhesion coat with an application rate of 6-8 sq.m per liter depending on the surface porosity.

The primer shall be allowed to dry for a minimum period of 2 to 4 hours time before the successive finishing coats of P.U. liquid membrane are applied. In any case successive finishing coat shall be applied within 24 hours.

The substrate shall be properly prepared by removing all loose materials by vigorous brushings, fungal growth with proprietary fungicide as recommended. Priming coat shall not be applied to damp substrate.

2.07.02 **Finishing Coats**

The finishing coats shall consist of two successive liquid coatings of high solid content urethane pre-polymers material to form an elastomeric membrane. Application shall be with brush or spray to form an uniform joint less elastomeric membrane. The overall dry film thickness shall be 1.5 mm subject to minimum 750 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for minimum of 150 mm over the finished roof surface or fillet with suitable tucking into the vertical wall surface. It shall be continued into rain water pipes by at least 100 mm.

The final coat of PU liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a layer of polyscric cloth/fabric are to be embedded between 2 finishing coats.

The entire work shall be carried out under the suspension of approved authorized agency.

2.07.03 **Surface Finish**

Areas of roof treatment shall be provided with wearing course consisting of minimum 25 mm thick PCC 1:11/2:3 (using 12.5 mm size aggregate) cast in panel of maximum size of 1.20 m x 1.20 m and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealant or elastomeric compound to ensure perfect waterproofing.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS: 13801 shall be provided. The tiles shall be laid as per IS 1443.





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2.08.00 Under Deck Insulation

2.08.01 Insulation material shall be Closed Cell Elastomeric Nitrile Rubber

2.08.02 Density of Material shall be between 40 to 60 Kg/m³

2.08.03 Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 W/m^{°K} at an average temperature of 0°C

2.08.04 The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990

2.08.05 Material should be FM (Factory Mutual), USA approved.

2.08.06 Water vapour permeability shall not exceed 0.017 Perm inch (2.48 x 10⁻¹⁴ Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor 'μ' value should be minimum 7000.

2.08.07 Under-deck insulation thickness shall be as per HVAC requirement and calculation.

2.08.08 Under-deck insulation shall be provided for all AC areas having roof/floor exposed to sun/hot environment.

2.09.00 Roof water proofing

2.09.01 Roof water proofing treatment shall be as follows:

After curing of the concrete, the roofs of building shall be provided with 3 layers, first being minimum 1.5mm thick elastomeric membrane waterproofing treatment coating with $\geq 500\%$ elongation confirming to ASTM C836 applied by a spray/brush/roller in two coats, secondly 120-150 GSM geotextile (non-woven polyester) shall be provided over the Elastomeric coating over which screed concrete (of M20 with 12mm blue metal chips) shall be laid and finally the wearing course. 1.5mm thick Elastomeric membrane shall be laid as per manufacturer's specification. Run off gradient shall be given a minimum of 1 in 100. Gradient shall comprise screed concrete M20 using 12.5 mm or below coarse aggregate and waterproofing treatment as per IS:2645, mixed with polypropylene fibres. Over the screed concrete wearing course treatment shall be provided as below:

A wearing course shall consist of pressed clay tiles of size 230x230x18 mm minimum laid in waterproofing compound mixed cement mortar (1:3) and sealing of joints using sealing compound.





2.09.02 For vertical surfaces (Parapet)

Surface preparation, minor cleaning works, removal of loose concrete, laitance, dust particles, etc. and filling cracks with polymer modified mortar using latex based bonding agent. Removal of algae if present is to be done. Providing and applying a water based acrylic primer over the entire surface of the parapet walls (2 part primer : 1 part water). Providing and applying 2 coats of a high performance elastomeric coating, composed of acrylic emulsion polymers having anti-carbonation properties, UV resistant and DFT of 110 microns, conforming to ASTM-D412-02, D1202-97, D 4587, D 4645, BS-EN 12390 over the exterior wall surface.

Note: *Waterproofing materials should be applied by the manufacturer in-house application wing or authorised applicators only under supervision of manufacturer's authorised person.*

3.00.00 ACCEPTANCE CRITERIA

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

4.00.00 I.S. CODES AND STANDARDS

- a) IS:73 : Paving Bitumen
- b) IS:702 : Industrial Bitumen
- c) IS:1203 : Methods of testing tar and bitumen
- d) IS:1322 : Bitumen felts for waterproofing and damp proofing
- e) IS:1346 : Code of Practice for waterproofing of roofs with bitumen felts
- f) IS:3384 : Bitumen primer for use in waterproofing and damp proofing.
- g) IS:2645 : Specification for integral water proofing compounds for cement mortar and concrete.
- h) IS:3144 : Methods of test for mineral wool thermal insulation materials.
- i) IS:4641 : Expanded polystyrene for thermal insulation purpose.





Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: XIII

**GUIDELINE
FOR
WATER SUPPLY**



Development Consultants Pvt. Ltd.

Volume: II-B
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Water Supply



**Tender Specification
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**GUIDELINE
FOR
WATER SUPPLY**

1.00.00 **SCOPE**

This section includes supply of all materials, labour and incidentals for water supply for industrial buildings. The water supply system of a building or premises covers service pipes and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the building or premises.

General Requirements

Any damage caused to the building, or to electric, sanitary water supply or other installations etc. therein either due to negligence on the part of the Bidder, or due to actual requirements of the work, shall be made good and the building or the installations shall be restored to its original condition by the Bidder. All water supply installation work shall be carried out through licensed plumber.

It is most important to ensure that wholesome water supply provided for drinking and culinary purpose is in no way liable to contamination from any less satisfactory water. There shall, therefore, be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for conveying or containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose. The provision of reflux or non-return valves or closed and sealed valves shall not be constructed a permissible substitute for complete absence of cross-connection.

Where a supply of wholesome water is required as an alternative or standby to supply of less satisfactory water or is required to be mixed with the latter, it shall be delivered only in to a cistern, and by a pipe or fitting discharging in to the air gap at a height above the top edge of the cistern equal to twice its normal bore, and in no case less than 15 cm.

No piping shall be laid or fixed so as to pass into, through or adjoining any sewer, scour outlet or drain or any manhole connected therewith nor through any ash pit or manure-pit or any material of such that can cause undue deterioration of the pipe.





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Where the laying of any pipe through fouled soil or previous material is unavailable, the piping shall be properly protected from contact with such soil or material by being carried through an exterior cast iron tube or by some other suitable means. Any piping or fitting laid or fixed which does not comply with the above requirements, shall be removed and re-laid in conformity with the above requirements.

The design of the pipe work shall be such that there is no possibility of backflow towards the source of supply from any cistern or appliance whether by siphonage or otherwise, and reflux or non-return valves shall not be relied upon to prevent such back flow.

All pipe work shall be so designed, laid or fixed, and maintained so that it remains completely watertight, thereby avoiding wastage of water damage to property and the risk of contamination of the water conveyed.

In designing and planning the layout of the pipe work, due attention shall be given to the maximum rate of discharge, required economy in labour and materials, protection against damage and corrosion, protection from frost, if required, and to avoidance of airlocks, noise transmission and unsightly arrangement.

To reduce frictional losses, piping shall be as smooth as possible inside. Methods of jointing shall be such as to avoid internal roughness and projection at the joints, whether of the jointing materials or otherwise.

Change in diameter and direction shall preferably be gradual rather than abrupt to avoid undue loss of head. No bend or curve in piping shall be made so as to materially reduce or alter the cross-section.

Underground piping shall be laid at such a depth that it is unlikely to be damaged by frost or traffic loads and vibrations. It shall not be laid in ground liable to subsidence, but where such ground cannot be avoided; special precautions shall be taken to avoid damage to the piping. Where piping has to be laid across recently disturbed ground, the ground shall be thoroughly consolidated so as to provide a continuous and even support.

Where the service pipe is of diameter less than 50mm the stop valves shall be of the screw-down type and shall have loose washer plates to act as non-return valves. Other stop valves in the service line may be of the gate type.

In flats and tenements supplied by a common service pipe a stop valve shall be fixed to control the each branch separately. In large buildings a sufficient number of stop valves shall be fixed on branch pipes, and to control groups of ball valves and draw off taps so as to minimize interruption of the supply during repairs, all such stop valves shall be fixed in accessible positions and properly protected from being tampered with, they may be of the gate type to minimize loss of head by friction.

Water for drinking or for culinary purposes as far as possible shall be on branch pipes connected directly to the service pipe.





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Pumps shall not be allowed on the service pipe as they cause a drop of pressure on the suction side thereby affecting the supply to the adjoining properties. In cases where pumping is required, a properly protected storage tank of adequate capacity shall be provided to feed the pump.

Service pipes shall be so designed and constructed as to avoid air-locks, so that all piping and fittings above ground can be completely emptied of water to facilitate repairs. There shall be draining taps or draw-off taps (not under ground) at the lowest points, from which the piping shall rise continuously to draw-off taps, ball valves, cisterns, or vents (where provided at the high points).

Service pipes shall be designed so as to reduce the production and transmission of noise as much as possible. Appliances which create noise shall be installed as far distant as possible from the living rooms of the house. High velocity of water in piping and fittings shall be avoided. Piping shall be confined, as far as possible, to rooms where appliances are fixed, it shall have easy bends, and where quietness is particularly desired, holder bats or claps shall be insulated from the piping by suitable pads.

The rising pipe to the storage cistern, if any, or to any feed cistern shall be taken as directly as possible to the cistern and shall be fixed away from windows or ventilators.

All pipe work shall be planned so that the piping is accessible for inspection, replacement and repair. To avoid its being unsightly, it is usually possible to arrange it in or adjacent to cupboards, recesses, etc. provided there is sufficient space to work on the piping with the usual tools. Piping shall not be buried in walls or solid floors. Where unavoidable, piping may be buried for short distances provided that adequate protection is given against damage and that no joints are buried. If piping is laid in ducts or chases, these shall be roomy enough to facilitate repairs and shall be so constructed as to prevent the entry of vermin. To facilitate removal of pipe casing, floor boards covering piping shall be fixed with screws or bolts.

When it is necessary for a pipe to pass through a wall or floor, a sleeve shall be fixed therein for insertion of the pipe and to allow freedom for expansion, contraction and other movement. Piping laid in wood floors shall, where possible, be parallel with the joints.

Where storage tanks are provided to meet overall requirements of water connection of service pipe with any distributing pipe shall not be permitted except one direct connection for culinary or drinking requirements.

No service pipe shall be connected to any water closet or urinal. All such supplies shall be from flushing cistern which shall have supply from storage tank.

No service or supply pipe shall be connected directly to any hot water system or to any apparatus used for heating other than through a feed cistern thereof.





1.01.00 **Materials**

All materials, fittings, fixtures and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Bidder shall submit samples of fittings and fixtures which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Bidder to procure the materials selected by the Engineer. Hence order is to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets and similar items shall be specially protected till final installation. Brass and other expensive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

1.02.00 **Pipes and Pipe Fittings**

Under scope of this specification, pipes and pipe fittings may be any or a combination of the following types:

- a) DI pipes
- b) P. V. C. Fittings/fixtures
- c) Copper fittings
- d) Brass fittings
- e) Galvanized Iron- heavy & medium duty pipes- is 1239 & is 4736

However for water supply in buildings only GI pipes of Medium class as per IS 1239 shall be used. And all the pipes shall be laid inside the buildings in concealed type

1.03.00 **Water Tanks**

Water tanks shall be made of HDPE, shall be factory made and from reputed brand with proper test certificates. The capacity of tanks shall be as per drawing design or as per instruction of Engineer-in-Charge.

1.04.00 **Related Works**

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply





systems shall come under scope of the Bidder unless specifically excluded. These works are not detailed out in this Specification.

1.05.00 **Regulation**

The work which is required to be carried out under the scope of this section, shall be executed by a licensed plumber only (engaged by the Bidder).

2.00.00 **INSTALLATION**

While basic layouts may be available in the drawings provided by the Owner, the details might have to be supplemented by the Bidder for approval of the Engineer.

Special attention shall be given by the Bidder to economy. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs and replacements of pipes, fittings and fixtures must be conveniently possible.

2.01.00 **Pipe Lines**

2.01.01 **Laying**

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. Pipes shall be encased or concealed in masonry or concrete if shown on drawing or directed by the Engineer.

2.01.02 **Back Flow**

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely water-tight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

2.01.03 **Contamination**

There shall be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose.





No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

2.01.04 **Underground Pipings**

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable.

The size and depth of the trench shall be as approved by the Engineer. Back-filling shall be done with selected fine earth, unless otherwise permitted in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support.

The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

2.01.05 **Concealed Piping**

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Bidder may co-ordinate with the building Bidder for leaving the chases, openings, conduits as necessary. However, the Bidder will rectify if required the chases, openings and conduits, supplement and make good after laying and testing of the concealed pipelines.

2.01.06 **Jointing of Pipes**

Jointing of pipes shall be completely leak proof and durable. Instruction of the manufacturer shall be followed unless desired otherwise by the Engineer. However, usually recommended practices are stated below for guidance:

a) **Steel**

Plain ended steel pipes may be jointed by welding. Screwed and socketed joints shall be carefully tightened. Care shall be taken to remove any burr from the ends of the pipes. Jointing compound, if used, shall be lead free and approved by the Engineer. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

b) **G I Pipes**

Threads shall be cut with sharp tools, and before jointing all scales shall be removed from pipes by suitable means. The screw / threads of the pipe shall be cleaned out and the joint made by screwing the fittings after treating the threads with approved pipe jointing





compound. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

2.01.07 **Painting**

Where mentioned , underground steel pipes shall be given 2 coats of bituminous paint on the outside after laying, when painting is to be done above ground G.I/MS/DI. pipes shall be given a coat of zinc ethyl silicate primer, And finish coats as specified elsewhere in this SPEC.

Polythene Water Storage Tanks

Material

Polythene used for manufacture of tanks and manhole lids may be high density (HDPE,) and shall conform to IS 10146. Polyethylene shall be compounded with carbon black so as to make the tank resistant to ultra violet rays from the sun. The percentage of carbon black content in polyethylene shall be 2.5 ± 0.5 percent and it shall be uniformly distributed. The materials used for the manufacture of tank, manhole lid and fittings shall be such that they neither contaminated the water nor impart any test, colour, odour or toxicity to water.

Manufacture and Finish

The tanks shall be manufactured by rotational moulding process. Each tank and the manhole lid shall be single piece having arrangement for fixing and locking the manhole lid with the tanks. Excess material at the mould parting line and near the top rim shall be neatly cut and finished. The internal and external surface of the tanks shall be smooth, clean and free from hidden internal defects like air bubbles, pit and metallic or other foreign material inclusion. Capacity of the tank, minimum weight of the empty tank (without manhole lid) and the manufacture brand name shall be embossed on the top surface of the tank near manhole.

Shape, Size and Capacity

The tank shall be cylindrical vertical with closed top having a manhole. Diameter and height of the tank of various capacities shall be as per manufacturer's specifications and a clearance of ± 3 percent shall be permitted on these dimensions. Capacity of the tank or up to the bottom of the inlet location whichever is less. Capacity of the tank shall be specified. Extra capacity if any shall be ignored.

Weight and Wall Thickness

The flat base of the tank shall be fully supported over its whole bottom area on a durable rigid flat and level platform sufficiently strong to stand without deflection the weight of the tank when fully filled with water. Depending upon





the capacity and the location tanks may be suitably anchored as per the directions of the Engineer-in-Charge. For inlet, outlet and other connections fully threaded GI, HDPE or PVC connections with hexagonal check nuts and washers on either side of the tank wall shall be provided. Holes for threaded connections shall be drilled and not punched. Pipes entering or leaving the tank shall be provided with unions and suitably supported on a firm base to avoid damage to the tank walls.

Manhole Lid

The lid shall rest evenly and fit over the rim of the manhole so as to prevent the ingress of any foreign matter in to the tank. The lid shall be provided with suitable arrangement for locking it with the tank.

The tank and its components shall conform to the local bye-laws for preventions of mosquito menace.

Sl. No.	Capacity (litres)	Minimum Wall Thickness (mm)	Minimum Weight of Empty Tank (kg)
1	2	3	4
1.	200	4.4	7.8
2.	300	4.4	9.0
3.	400	5.5	15.0
4.	500	6.0	18.0
5.	700	7.0	23.5
6.	1000	6.6	33.0
7.	1250	7.0	40.0
8.	1500	7.0	47.0
9.	1700	7.0	54.0
10.	2000	7.0	64.0
11.	2500	8.2	81.0
12.	3000	8.2	96.0
13.	4000	8.8	138.0
14.	5000	10.4	191.0
15.	6000	10.7	209.0
16.	7500	10.7	250.0
17.	10000	11.5	363.0
18.	15000	11.5	550.0
19.	20000	13.2	814.0

2.02.00

Valve, Cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian Standard Specification and shall be of best quality from approved manufacturers. These shall be suitable for working pressures mentioned elsewhere in the specification.. Nominal size and material shall be as Specified.2.03.00

Protection





Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets or spigot are not damaged and no foreign material can find its way into the pipe line.

Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

3.00.00 **TESTING AND ACCEPTANCE**

3.01.00 **Inspection Before Installation**

All pipes, fittings and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

3.02.00 **Testing of Mains after Laying**

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/CM² or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a water-tight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

3.03.00 **Testing of Service Pipes and Fittings**

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely water-tight. All piping, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion and frost.

4.00.00 **I.S.CODES**

Important relevant IS Codes for this Specification are listed below :

Latest editions shall always be consulted.

IS:2065 : Code for Practice for water supply in buildings

IS:1172 : Code of basic requirements for water supply, drainage and sanitation





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- IS:1200 : Laying of water and sewer lines including (Pt.XVI) appcurtnant items.
- IS:1239 (Pt. I & II) : Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter)
- IS:1536 : Specification for Centrifugally cast (Spun) iron pressure pipes for water gas and sewage
- IS:1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage.
- IS:3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter)
- IS:3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter)
- IS:784 : Prestressed concrete pipes
- IS:458 : Concrete pipes (with or without reinforcement)
- IS:783 : Code of Practice for laying of concrete pipes
- IS:1592 : Asbestos cement pressure pipes
- IS:1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types)
- IS:404 : Lead pipes
- IS:3076 : Low density polyethylene pipes for potable water supplies
- IS:4984 : High density polyethylene pipes for potable water supplies
- IS:2501 : Copper tubes for general engineering purposes
- IS:407 : Brass tubes for general purposes
- IS:1230 : Cast iron rain water pipes and fittings
- IS:804 : Rectangular pressed steel tanks
- IS:4736-1986 : Hot-dip zinc coatings on steel tubes. (Reaffirmed – 2001)





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**VOLUME: II-B
SECTION: I
PART: C
SUB SECTION: XIV
GUIDELINE
FOR
DRAINAGE AND SANITATION**



Development Consultants Pvt. Ltd.

Volume: II-B
Section: I; Part C; Sub Section: XIV
Drainage and Sanitation



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**VOLUME: II-B
SECTION: I**

PART: C

SUB SECTION: XIV

**GUIDELINE
FOR
DRAINAGE AND SANITATION**

1.00.00 **SCOPE**

1.01.00 This section covers the layout and construction of drains for roof water, surface water and sewage together with all fittings and fixtures and inclusive of ancillary works, such as connections, manholes and inspection chambers used within the building and from the building to the connection to a plant sewer or treatment work.

2.00.00 **INSTALLATION**

2.00.01 **General**

All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipe lines, fittings and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

2.01.00 **Rainwater Down comers & Soil and Drainage Pipes**

Rainwater down-comers shall be standard, DI Pipes. .

Rainwater downcomers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure.

All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.





Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

2.01.01 **Unplasticized Polyvinyl Chloride (UPVC) Pipes (for sanitary lines above GL)**

The specification covers requirements for plain and socket end unplasticised polyvinyl chloride (UPVC) pipes with nominal outside diameters 40 mm to 160 mm for use for soil and waste discharge system inside buildings including ventilating and rain water applications. In this specification nominal outside diameter DN of pipes are 40, 50, 63, 75, 90, 110, 125, 140 and 160 mm.

Surface colour of the pipes shall be dark shade of grey. For other details and specifications refer code IS: 13592-1992 (amended to 1995)

Above quality of pipes are divided into two types. Type –A (IS 13592) meant for rain water pipes & Type- B meant for soil pipes.

The water supply pipes for the building shall be of CPVC.

Colour of Pipe

Surface colour of the pipes shall be dark shade of grey or as specified.

Marking

Each pipe shall be clearly and indelibly marked with the following information at intervals not more than 3 meters.

- a) Manufacturer's name or trade mark.
- b) Nominal outside dia of pipe.
- c) Type 'A'
- d) Batch number.

Dimensions

Diameter and Wall Thickness : Mean outside diameter, outside diameter at any point and wall thickness for type-A or type-B manufactured plain or with socket shall be as given in Table-1 of IS 13592.

Fixing and Jointing

Pipes shall be secured to the walls at all joints with PVC Pipes clips by means of 50 x50x50 mm hard wood plugs, screwed with M.S. screws of required length i/e cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand). The clips shall be kept about 25 mm clear off finished face of





wall, so as to facilitate cleaning of pipes. Pipes shall be fixed perfectly vertical or to the lines as directed. The pipes shall be fitted to fittings with seal ring conforming to IS 5382 allowing 10 mm gap for thermal expansion.

Installation in Wall/ Concrete

The walls/concrete slots should allow for a stress free installation. Pipes and fittings to be inserted in to the slots without a cement base have to be applied first with a thin coat of PVC solvent cement followed by sprinkling of dry sand (medium size). Allow it to dry. The process gives a sound base for cement fixation.

Fittings

Fittings used shall be of the same make as that of the PVC pipes injection moulded or fabricated by the manufacturer and shall have a minimum wall thickness of 302 mm. The fittings shall be supplied with grooved socketted ends with square grooves and provided with Rubber Gasket conforming to IS 5382. The plain ends of the fittings should be chamfered. The fittings shall be joined with the help of Rubber lubricant. The details of fittings refer IS 13592.

2.01.03

Pipes-Galvanised Iron

The pipes (tubes) shall be galvanized mild steel hot finished seamless (HFS) or welded (ERW) HIRW or HFW screwed and socketted conforming to the requirements to IS 1239 Part – I for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

Galvanising shall conform to IS 4736 : The zinc coating shall be uniform adherent, reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare patches, black spots, pimples, lumping runs, rust stains, bulky white deposits and blisters. The pipes and sockets shall be clearly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be cleaned and well cut. The ends shall be cut clearly and square with the axis of the tube.

All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

All tubes shall withstand a test pressure of 50 kg/sq.cm without showing defects of any kind.

Fittings : The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS 1239 (Part-2) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.





2.02.00 **Gutters**

The gutters shall be made of G.I. or as specified elsewhere in the contract. All gutters shall be supplied by reputable specialized firms. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no reflection even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by rivetting, bolting or soldering. All joints between successive lengths of gutters shall have an overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

2.03.01 **Gradients**

If not specified the minimum gradients of soil and drainage pipe line shall be as follows :

100 mm nominal dia	:	1 in 35
150 mm nominal dia	:	1 in 65
230 mm nominal dia	:	1 in 120
300 mm nominal dia	:	1 in 200

2.03.02 **Relation with water supply pipe lines**

Unless specifically cleared by the Engineer, under no circumstances shall special drainage and soil pipes be allowed to come close to water supply pipelines.

2.03.03 **Laying**

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

2.03.04 **Support and Protection on Pipelines**





All pipes shall be laid with sockets leading uphill. For on/above ground level, Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. For underground PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

For above ground level the pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

2.03.05 **Entry into structures**

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipe lines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

2.03.06 **Ducts**

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin or backflow.

2.03.07 **Traps and Ventilating Pipes**

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap.

Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown





on drawings. All vertical ventilating, anti-siphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C.I. unless desired otherwise by the Engineer.

2.03.08 **Manhole and Inspection Chambers**

All manholes and inspection chambers shall be in RCC. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. In addition, at every change of alignment gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise.

Manhole shall be constructed so as to be watertight under test. The bending at the sides shall be carried out in such a manner as to provide no lodgment for any splashing in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Manholes shall be provided with standard C.I. covers. The covers shall be close fittings so as to prevent gases from coming out. Suitable heavy duty covers shall be used where necessary as decided by the Engineer.

2.03.09 **Cutting of Pipes**

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

2.03.10 **Jointing**

Jointing of laid pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water-tight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer.

2.04.01 **Trenches and other excavations**

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.





Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Bidders from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimise inconvenience of traffic where applicable.

2.05.00

Fixtures

The successful bidder shall furnish the type and make of the fixtures he intends to use enclosing manufacturer's current catalogues. In the absence of any such agreement, the Engineer shall be at liberty to choose any type and make.

All fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site must bear identification marks of the type of the manufacturer. Procurements shall be made well in advance and inspected and approved immediately by the Engineer. All fixtures shall be adequately protected, covered and plugged till handed over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bends shall weigh at least 3 kg. per 25 mm dia per meter length. Where PVC or similar pipes are allowed the Bidder shall produce the test reports and convince the Engineer about their durability.

Unless specified in the contract the fixtures shall be as specified hereinafter.

2.05.01

Water closet





a) **Raised type**

It shall include glazed vitreous china basin with siphon, open front solid plastic seat and plastic cover, low level PVC flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as desired by the Engineer.

b) **Squatting type**

It shall include glazed vitreous china pan with foot rests and high level PVC flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of white glazed vitreous china with chequered surface.

2.05.02 **Urinals**

It shall consist of wall type glazed vitreous china urinals, PVC/ glazed stoneware automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Automatic flushing shall be approximately once in every five minutes. For a number of urinals located together may be served by one cistern of adequate capacity. All fittings shall be chrome plated. Sensor based urinals shall be provided at important areas as decided by the Engineer in charge

2.05.03 **Wash basin**

It shall be made of glazed vitreous china. The basin shall be flat back, wall hung by painted cast iron brackets and complete with pattern with hot and cold brass faucets with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste complete with necessary fittings. All fittings including faucets shall be chromium plated. The washbasins preferably oval shaped fitted on Granite Top.

2.05.04 **Sink**

It shall be made of glazed stoneware. It shall be wall hung by painted cast iron brackets and complete with one brass faucet with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste with necessary fittings. All fittings including faucets shall be chromium plated.

2.05.05 **Bathroom mirror**

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws and other fittings shall be chromium plated.

2.05.06 **Glass shelves**





Glass shelves shall consist of 6 mm thick clear glass with guard rails and shall be wall mounted with brackets. All brackets, guard rails and screws shall be chromium plated.

2.05.07 **Towel rail**

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

2.05.08 **Soap holder**

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium plated screws.

2.05.09 **Liquid soap dispenser**

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

2.05.10 **Toilet roll holder**

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screws shall be chromium plated.

2.05.11 **Installation**

All plumbing fittings and fixtures shall be installed in most workmanlike manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and floors. All cuttings in walls and floors shall be made good by the Bidder.

3.00.00 **TESTING AND ACCEPTANCE**

3.01.00 **Inspection before installation**

All pipes, fittings and fixtures shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

3.02.00 **Testing of Pipelines**

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below :

a) **Smoke test**





All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

b) **Water test**

For pipes other than Cast Iron

Glazed ware and concrete pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimeter of diameter per kilometer may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may due to one or more of the following cases :

- a) Absorption by pipes and joints
- b) Sweating of pipes or joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

c) **For straightness**

- i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end; and





- ii) By means of a mirror at one end of the line and lamp at the other. If the pipe line is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipe line is not straight.

3.03.00 **Fixtures etc.**

All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted.

4.00.00 **CODES AND STANDARDS**

Some of the important Codes and Standards relevant to this specification shall be followed: Latest editions shall always be consulted.

- IS: 1172 - Code of basic requirements for water supply drainage and sanitation.
- IS: 1200 - Laying of water and sewer lines including appurtenant (Pt. XVI) items.
- IS: 1239 - Mild Steel Tubes and Mild Steel Tubular and other (Pt.I & II) wrought steel pipe fittings.
- IS: 1536 - Centrifugally cast (Spun) iron pressure pipes for water gas and sewage.
- IS: 1537 - Vertically cast iron pressure pipe for water, gas & sewage.
- IS: 3486 - Cast Iron spigot & socket drain pipes.
- IS: 1742 - Code of Practice for building drainage.
- IS: 5329 - Code of Practice for sanitary pipe work above ground for buildings.
- IS: 2470 - Code of Practice for designs and construction of septic tank for small and large installations.
- IS: 3076 - Low density polythelene pipes for potable water supplies.
- IS: 4984 - High density polythelene pipes for potable water supplies.
- IS: 1537 - Vertically cast iron pressure pipes for water, gas and sewage.
- IS: 1538 - Cast Iron fittings for pressure pipes for water, gas & sewage.
- IS: 1230 - Cast Iron rain water pipes and fittings.





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- IS: 3889 - Centrifugally cast (spun) iron spigot & socket soil waste and ventilating pipes, fittings and accessories.
- IS: 1729 - Sand cast iron spigot & socket soil, waste and ventilating pipes and accessories.
- IS: 1626 - Asbestos cement building pipes, gutters and fittings (spigot & socket types).
- IS: 458 - Concrete pipes (with and without reinforcement)
- IS: 783 - Code of Practice for laying of concrete pipes.
- IS: 784 - Prestressed concrete pipes.
- IS: 651 - Salt glazed stoneware pipes & fittings.
- IS: 4127 - Code of practice for laying of glazed stoneware pipes.
- IS: 1726 - Cast Iron manhole covers and frames intended for use in drainage works.
- IS: 5961 - Cast Iron gratings for drainage purposes.
- IS: 5219 - 'P' & 'S' traps.
(Part 1)
- IS: 771 - Glazed earthen-ware sanitary appliance.
- IS: 772 - General requirements of enamelled cast iron sanitary appliances.
- IS: 774 - Flushing cistern for water closets & urinals (valve less siphonic type).
- IS: 775 - Cast Iron brackets & supports for wash basins and sinks.
- IS: 2548 - Plastic water closet seats & covers.
- IS: 2527 - Code of Practice for fixing rain water gutters and down-pipes for roof drainage.
- IS: 1703 - Water fittings- copper alloy float valves (horizontal plunger type)
- Specification.
- IS: 1795 - Specification for pillar taps for water supply purpose.
- IS: 2556 (Part-1, Part-2, Part-3, Part-4, Part-5, Part-6, Part-7, Part-14, and Part-15)
 - Part-1: General requirements
 - Part-2: Specific requirements of wash-down water closets.
 - Part-3: Specific squatting pans.
 - Part-4: Specific requirements of wash basins.





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- Part-5: Specific requirements of laboratory sinks.
 - Part-6: Specific requirements of Urinal & Partition plates.
 - Part-7: Specific requirements of accessories for sanitary
 - Part-14: Specific requirements of integrated squatting pans.
 - Part-15: Specific requirements of universal water closets.
- IS: 3989 - Specification for centrifugally cast (9spun) iron spigot and Socket soil, waste and ventilating pipes fittings and accessories.
- IS: 4827 - Specification for electroplated coating of nickel and chromium on copper and copper alloys.
- IS: 4985 - Unplasticised P.V.C pipes for potable water supply- Specifications.
- IS: 4127 - Code of Practice for Laying of Glazed Stone Ware Pipes.
- IS: 4885 - Specifications for Sewer Bricks.
- IS: 12592 - Pre-cast Concrete Manhole Covers and Frames – Specifications.





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

VOLUME: II-B

SECTION: I

PART: C

SUB SECTION: XV

**GUIDELINE
FOR
FLY ASH BRICKS**



Development Consultants Pvt. Ltd.

**Volume: II-B
Section: I; Part C; Sub Section: XV
Fly Ash Blocks / Bricks**



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**VOLUME: II-B
SECTION: I**

PART: C

SUB SECTION: XV

**GUIDELINE
FOR
FLY ASH BRICKS**

1.00.00 SCOPE

This document lays down the specific technical requirements regarding classification, general quality, dimensions and physical requirements of pulverized fuel ash – Cement Bricks which may be used as per instruction of Engineer-in-charge.

2.00.00 CODES & STANDARDS

The following Indian Standards contain provisions which, through reference in this text, constitute provision of this document.

IS 12894: 2002	:	Pulverized Fuel Ash-Lime bricks - Specification
IS 712: 1984	:	Specification for building limes
IS 1727: 1967	:	Methods of test for pozzolanic materials
IS-269-1989	:	Ordinary Portland cement 33 grade specification
IS-8112-1989	:	Ordinary Portland cement 33 grade specification
IS-12269-1987	:	Ordinary Portland cement 53 grade specification
IS: 3812-2003(PART1)	:	Pulverized fuel ash specifications for use of pozzolona in cement, cement mortar and concrete
IS-3812-2003(PART 2)	:	Pulverized fuel ash specifications for use as admixture in cement mortar and concrete
IS 3495(Part1): 1992	:	Determination of compressive strength of burnt clay building bricks
IS 3495(Part 2)1992	:	Determination of water absorption of burnt clay building bricks
IS 3495(Part 2)1992	:	Determination of efflorescence of burnt clay building bricks
IS 3812: 1981	:	Specification for fly ash for use as pozzolana and admixture





IS 4139: 1989 : Specification for calcium silicate bricks
IS 5454: 1978 : Methods for sampling of clay burnt building bricks

3.00.00 GENERAL REQUIREMENTS

Visually the bricks shall be sound, compact and uniform in shape. These shall be free from visible cracks, warpage and organic matters. The bricks shall have smooth rectangular faces with sharp corners and shall be uniform in shape, texture and colour. When broken they shall leave no lumps or grit.

4.00.00 CLASSIFICATION

Pulverized fuel ash-cement bricks shall be classified on the basis of average wet compressive strength as given below:-

Table 1

Class Designation	Average wet compressive strength not less than
10	100 kgf/cm ²
7.5	75 kgf/cm ²
5	50 kgf/cm ²

5.00.00 DIMENSIONS AND TOLERANCES

5.01.00 Dimensions

The Dimension of Fly ash bricks shall be 230X110X75

5.02.00 Tolerances

The dimensional tolerance of bricks shall be as outlined in Cl. 5.2 of IS 12894: 2002 and IS 2185: 1979

6.00.00 MATERIALS

6.01.00 Pulverized Fuel Ash (Commonly known as Fly Ash)

Pulverized fuel ash commonly known as fly ash collected from ESP shall conform to Grade 1 or Grade 2 of IS 3812.





6.02.00 Sand/Stone Dust/Aggregates

Contractor shall use available sand/stone dust which is used for concrete work. The following practice generally followed:

Deleterious materials, such as clay and silt in sand/stone dust shall preferably be less than 5 percent as per IS 12894:1990. Field test with the help of measuring cylinder to ascertain percentage of deleterious materials should be carried for every truck load of sand/stone dust.

6.03.00 Cement

Cement used shall be ordinarily Portland cement conforming to Code for ordinary cement in IS 8112:1989 for 43 grades and shall be fresh when delivered. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

6.04.00 Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discolouration, efflorescence etc.

6.00.00 Proportioning of Raw Materials

Fly ash: 50-60%
Sand/stone dust: 30-40%
Cement: 8 to 10%

The strength of the bricks manufactured with above proportion shall be at least of 7.5 N/sqmm after 28 days.

Mix proportions stated above can be utilized as guide lines. Based on the quality of raw materials, the exact mix proportion may be finalized by trial mixes to produce good quality bricks of required compressive strength. The above proportions are tentative and shall be revalidated by getting tested at approved lab. The contractor shall seek approval from the owner before carrying out mass manufacturing. Owner shall check the quantities as and when he deems fit. In any case if a source of any raw material is changed, owner's approval to taken and manufactured bricks shall be tested.





7.00.00 PHYSICAL CHARACTERISTICS

7.01.00 Compressive Strength

The minimum average wet compressive strength of pulverized fuel ash-cement bricks shall not be less than the one specified in Table 1 (shall satisfy minimum class 5) when tested as described in IS 3495 (Part 1). The wet compressive strength of any individual brick shall not fall below the minimum average wet compressive strength specified for the corresponding class of bricks by more than 20 percent.

7.02.00 Drying Shrinkage

The average drying shrinkage of the bricks when tested by the method described in IS 4139, being the average of three units shall not exceed 0.15 percent.

7.03.00 Efflorescence Test

The bricks when tested in accordance with the procedure laid down in IS 3495 (Part 3) shall have the rating of efflorescence not more than "moderate".

7.04.00 Water Absorption

The bricks when tested in accordance with the procedure laid down in IS 3495 (Part 2), after immersion in cold water for 24 hours, shall have average water absorption not more than 20 percent by mass.

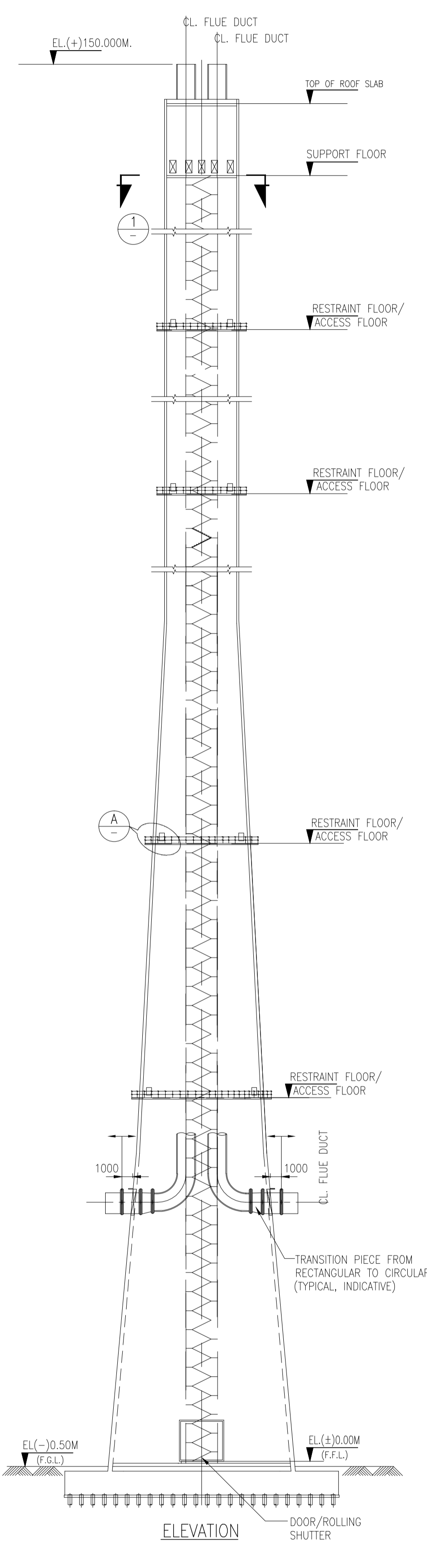
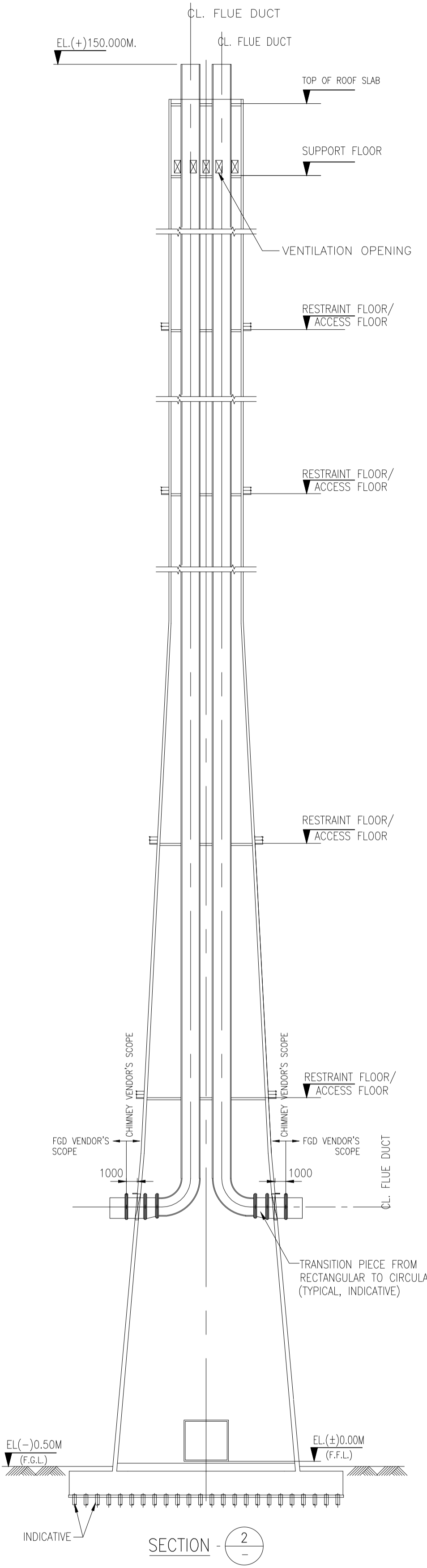
8.00.00 SAMPLING AND CRITERIA FOR CONFORMITY

Sampling and criteria for conformity of the bricks shall be as given in IS 5454.

9.00.00 MARKING

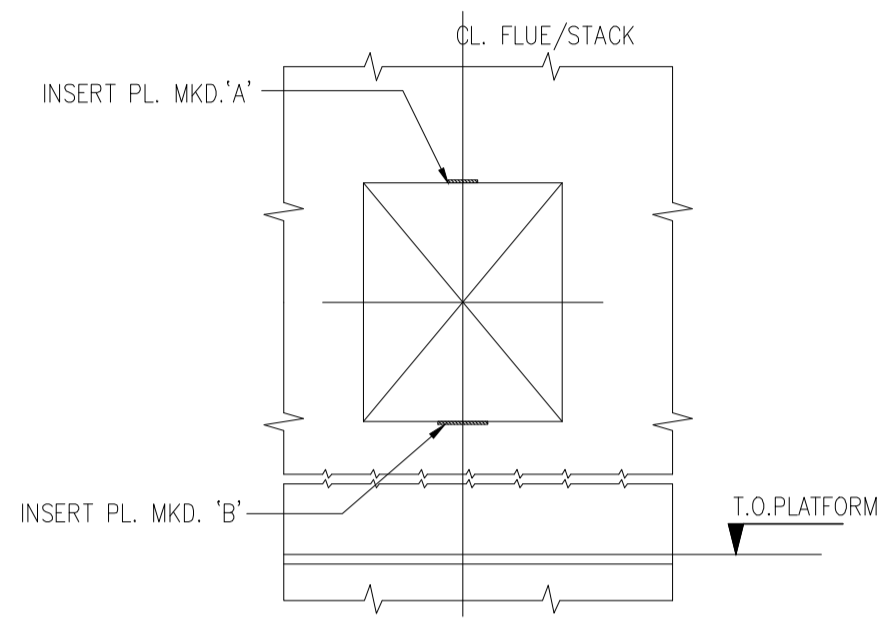
Each brick shall be marked in a suitable manner with the manufacturer's identification mark or initials.



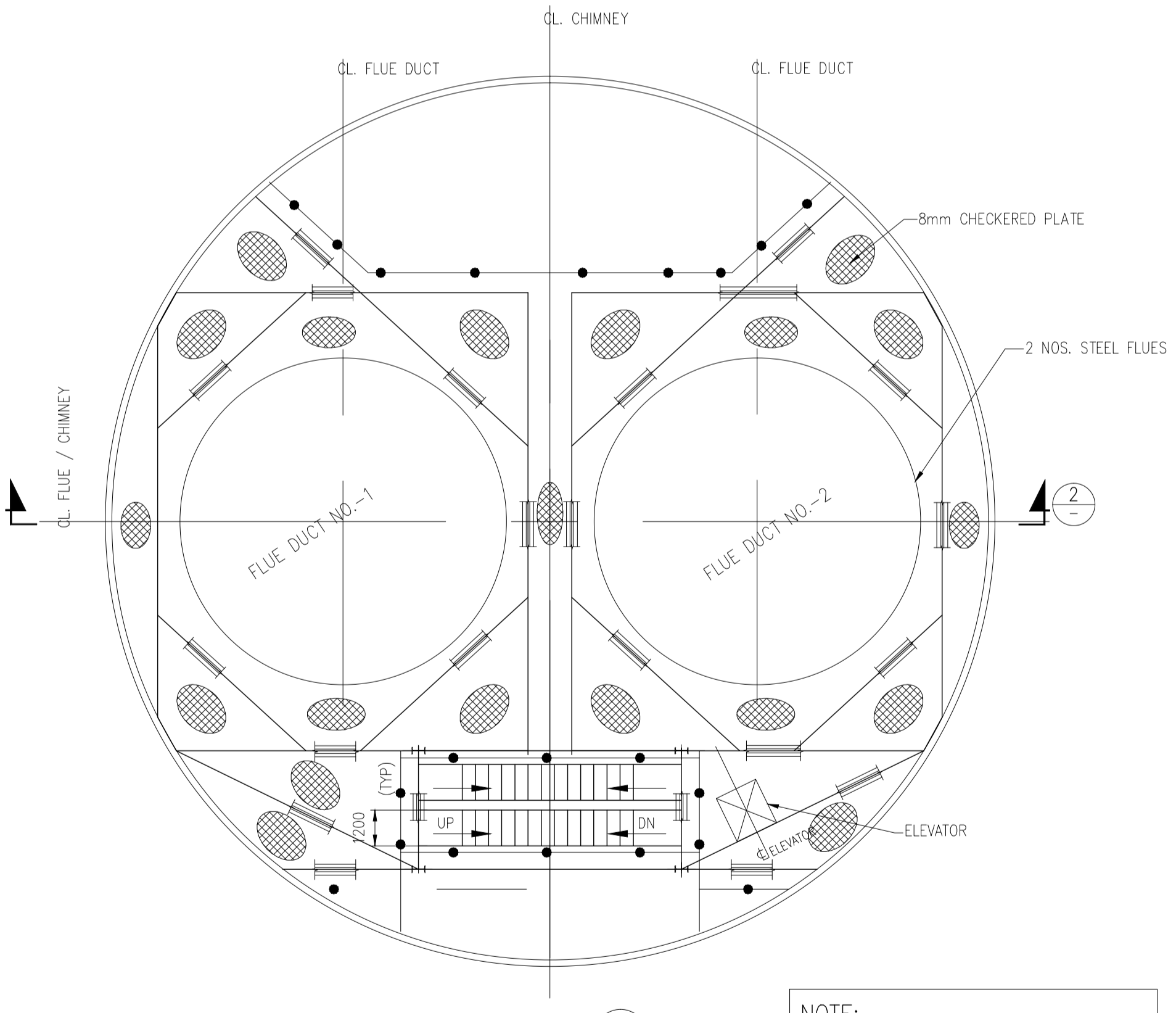


- OPENING FOR THE FOLLOWING PORTS TO BE PROVIDED ON SHELL OF CHIMNEY:
- 1) HF ANALYZER
 - 2) MERCURY ANALYZER
 - 3) OXYGEN ANALYZER
 - 4) FLUE GAS FLOW MEASUREMENT
 - 5) SO₂/NO_x/CO/CO₂ ANALYZER
 - 6) FLUE GAS TEMPERATURE MEASUREMENT
 - 7) OPACITY MONITOR
 - 8) MANUAL SAMPLING

NOTE:-
LOCATION OF TEST PORTS AND SAMPLING POINTS SHALL BE STRICTLY AS PER LATEST CPCB / TNPCB NORMS & REGULATIONS.

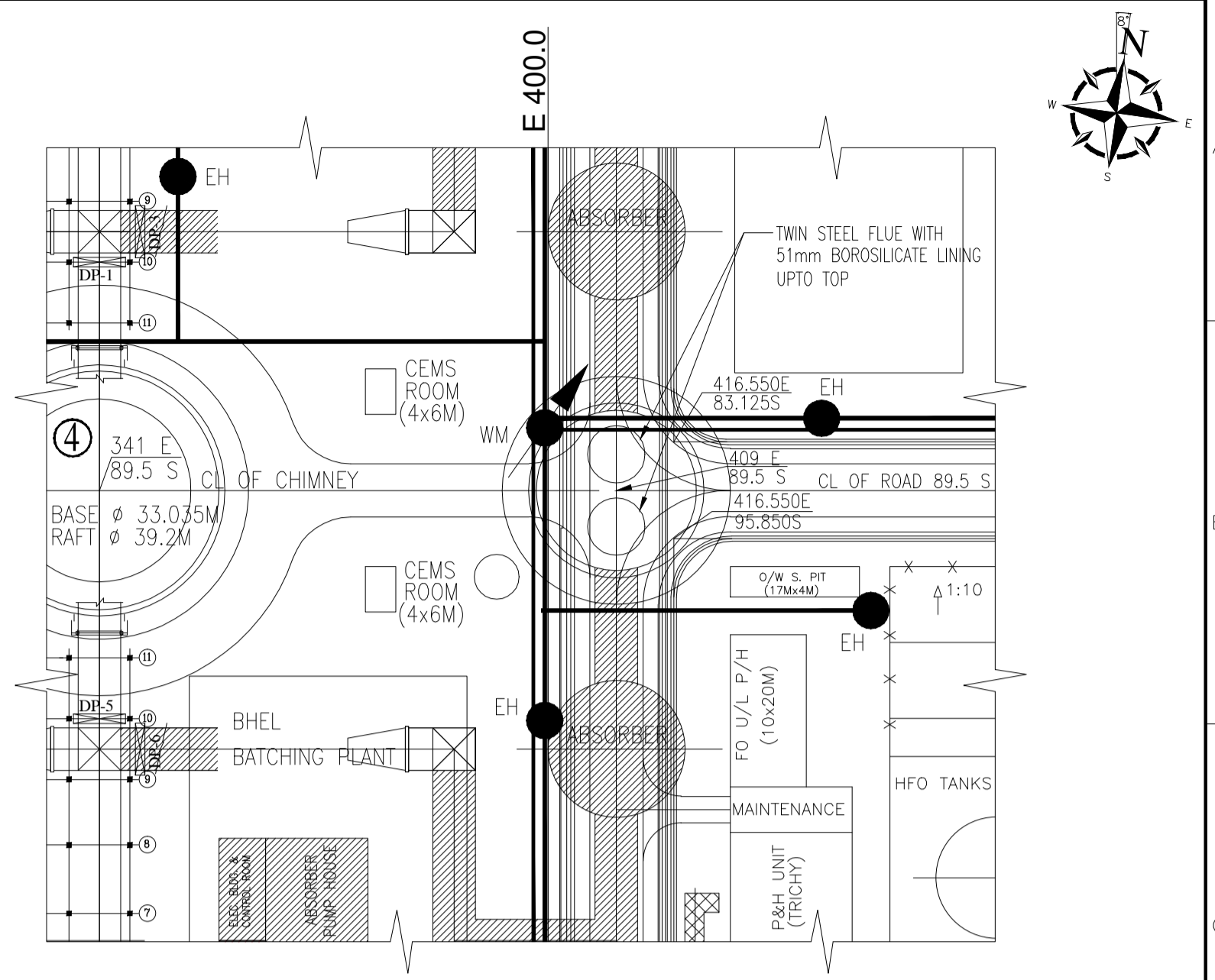


DETAIL - A
(OPENING FOR AVIATION LAMP @ 90° ALONG PERIPHERY)

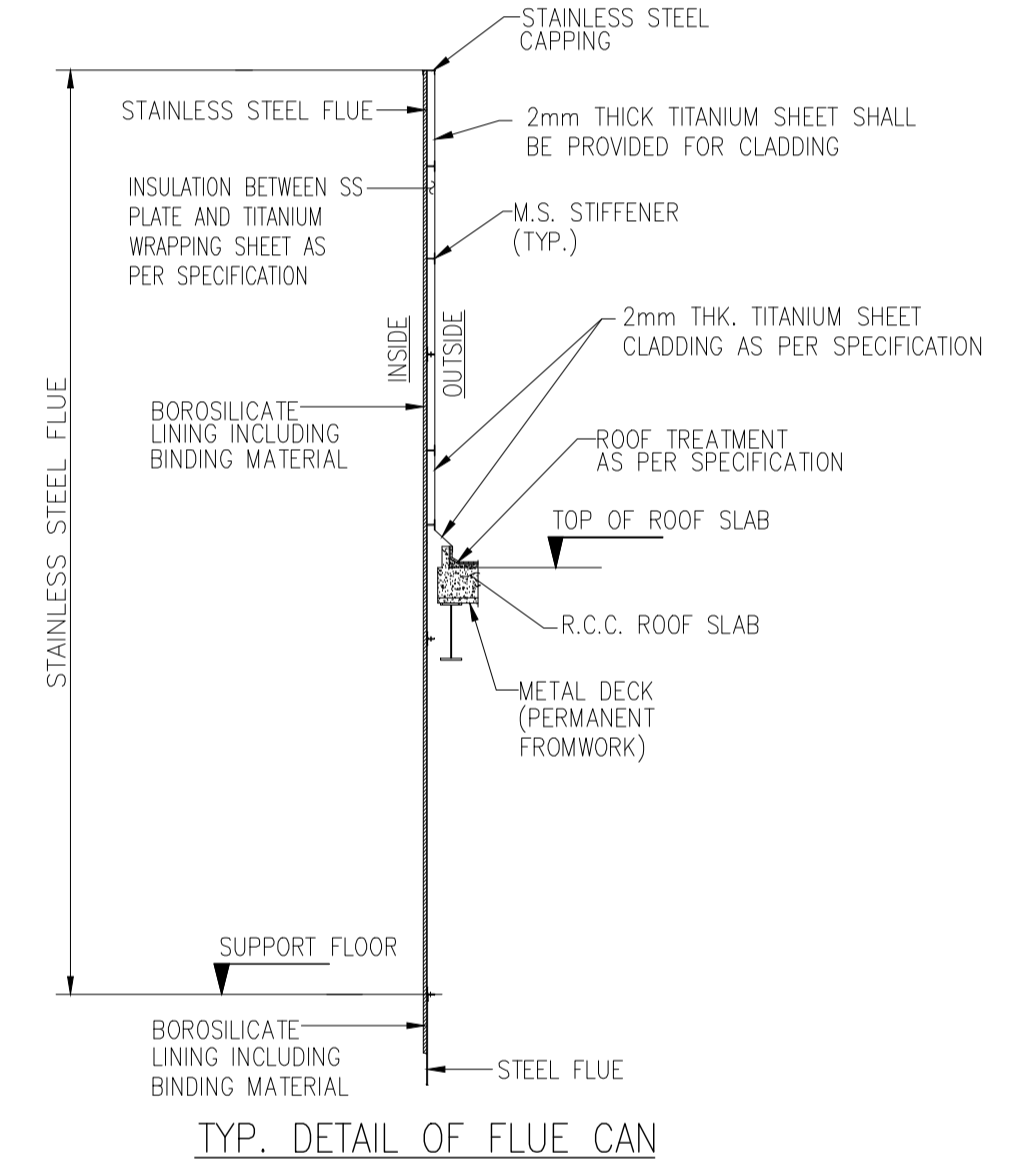


SECTION - 1
SCALE-1:100

NOTE:-
MINIMUM FOUR (4) NUMBER OF EXTERNAL PLATFORM SHALL BE PROVIDED AS PER SPECIFICATION



KEY PLAN
SCALE-1:500



TYP. DETAIL OF FLUE CAN

- NOTES:-
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METER UNLESS OTHERWISE NOTED.
 2. DIAMETER OF STEEL FLUE WILL BE FINALISED DURING DETAIL ENGINEERING STAGE BY THE BIDDER.
 3. STACK ELEVATOR SHALL BE SUPPLIED ALONG WITH THE CHIMNEY.
 4. ACCESS FLOOR LEVELS WILL BE FINALISED DURING DETAIL ENGINEERING.
 5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CHIMNEY SPECIFICATIONS.

FOR TENDER PURPOSE ONLY

THIS DRAWING IS FOR TENDER PURPOSE ONLY. ACTUAL SIZE, ARRANGEMENT, FOUNDATION SYSTEM, THICKNESS, DIMENSIONS, ELEVATION ETC. SHALL BE DETERMINED AND FINALIZED DURING DETAIL ENGINEERING STAGE.

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY FOR TENDER ONLY	23.06.20	AR
FOR CONSTRUCTION		
REVIEWED		
CIVIL & STRUCTURAL		
ELECTRICAL		
INSTRUMENTATION		
MECHANICAL		

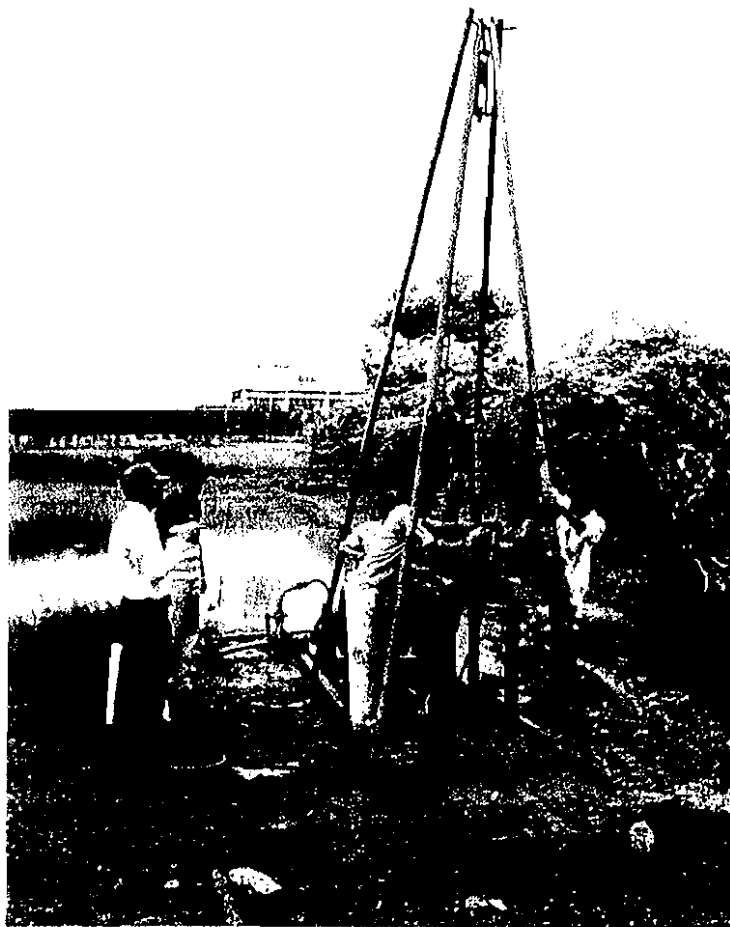
	OWNER: NLC TAMILNADU POWER LIMITED
	PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN
	TITLE: GENERAL ARRANGEMENT OF 150M HIGH BI-FLUE CHIMNEY
	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI
PREPARED CHECKED APPROVED	ASHS/PS NC AR
DWG. NO.	18A09-DWG-C-0001
JOB NO.	18A09
SCALE	AS NOTED
DATE	23.06.20
REV 0	1 SHEET OF 1

A REPORT ON SOIL INVESTIGATION FOR PROPOSED 2 X 500 MW NLC THERMAL POWER STATION AT TUTICORIN

Client:

NEYVELI LIGNITE CORPORATION

VOLUME-I



Prepared By:

Geostruct Engineering & Testing Services

8-sahajanand co-op industrial estate

Munjmahuda Baroda-390021

Ph (0265) 2341590 Fax: (0265) 2358415

Email: geostruct_engg@yahoo.com

Submitted: June - 2005

SUBSURFACE INVESTIGATION FOR PROPOSED 2 X 500 MW
THERMAL POWER STATION AT TUTICORIN

VOLUME-1

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ISO 9001 : 2000
Reg. No. : R91/1462

GETS/2005/811

GEOSTRUCT

ENGINEERING & TESTING SERVICES

8 Sahajanand Indul. Estate, Munjmahuda,
Padra Road, Vadodara - 390020,
Phone : 0265-2341590
Fax : 0265-2358415
Email : geostruct_engg@yahoo.com

24.08.2005

SOIL INVESTIGATION FOR PROPOSED 2 x 500 MW NLC THERMAL POWER PROJECT AT TUTICORIN, TAMIL NADU.

1.0 INTRODUCTION

M/s Neyveli Lignite Corporation Ltd has proposed to put up 2 x 500 M.W Thermal Power Station at Tuticorin in the Port Trust area. The work of conducting subsurface investigation was awarded to M/s Geostruct Engineering & Testing Services Baroda Vide Letter of Intent Lr. No. TM/IV/T.No.64/2004/CGM/C/2005 Dated 18.02.2005.

The object of the sub soil exploration was (i) To determine the probable sub surface conditions such as stratification, denseness or hardness of the strata, position of ground water table, Static and dynamic properties of soil (ii) To suggest suitable type of foundation along with load bearing capacity.

The Power plant is proposed to be located at Tuticorin Port Trust area near the existing Toothukudi Thermal Power station of TNEB.

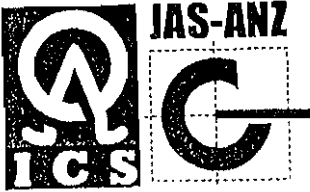
This report is in two volumes

Volume -1 covers description of tests carried out, recommendation of safe bearing capacity for different of foundations.

Volume -2 covers borelogs, trialpit logs, stratification sections, graphs and tables.

2.0 FIELD WORK

The actual investigation work was started on 17-04-2005 and was completed on 30.05.2005.



ISO 9001 : 2000
Reg. No. : R91/1462

Project: Soil Investigation for proposed 2 x 500 MW NLC Thermal Power Station at Tuticorin

Report No. GETS/2005/811 dated 24.08.2005

2.1 Boreholes and Trial Pits

Twenty boreholes of 150mm diameter were drilled through the soil up to 5.0m depth in rocky strata. The depth of boreholes varied from 8.5m to 20.0m below existing ground level depending upon the depth at which rock was encountered. The work was in general accordance with IS: 1892 – 1979. The boreholes were located as shown in the location plan attached as Plate - 1. Plate 2 to 21 shows the bore logs detail.

Ten trial pits (3m x 3m) are excavated for visual observation of substrata up to depth of 3.0m. Unconfined compression test were conducted using pocket penetrometer in the field and disturbed / undisturbed samples are collected from each trial pit for laboratory testing (Plate 22 to 26).

2.1.1 Disturbed Samples

Disturbed representative samples were collected, logged, labelled and placed in polythene bags.

2.1.2 Undisturbed Samples

Undisturbed soil samples are collected in 70mm / 100 mm diameter thin walled sampler (Shelby tube) from the borehole. The sampler used for the sampling had smooth surface and appropriate area ratio and cutting edge angle thereby minimising disturbance of soil during sampling.

2.1.3 Water Samples

Water table encountered at a depth of about 0.18m to 0.70m below ground level during the sub soil exploration work carried out in the month of April - May 2005. Water samples were collected in 1 litre PVC cans from each borehole for chemical analysis.

2.1.4 Method of Sampling

Sampler was coupled together with a sampler head to form a sampling assembly. The sampler head provide a non-flexible connection between the sampling tube and the drill



ISO 9001 : 2000
Reg. No. : R91/1462

Project: Soil Investigation for proposed 2 x 500 MW NLC Thermal Power Station at Tuticorin

Report No. GETS/2005/811 dated 24.08.2005

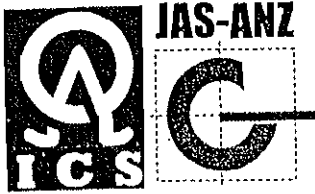
rods. Vent holes are provided in the sampler head to allow escape of water from the top of sampler tube during penetration. The sampling tubes were made free from dust and rust. Coating of oil was applied on both sides to obtain the undisturbed samples in best possible manner.

The sampler was then lowered inside the borehole on a string of rods and driven to a pre-determined level. On completion of driving the sampler is first rotated within the borehole to shear the soil sample at bottom and then pulled out. Upon removal of the sampling tubes, the length of sample in the tube was recorded. The disturbed material in the upper end of the tube, if any, was completely removed before sealing.

The soil at the lower end of the tube was trimmed to a distance of about 10 to 20 mm. After cleaning and inserting an impervious disc at each end, both ends were sealed. The empty space in the sampler, if any, was filled with the moist soil, and the ends covered with tight wrapper. The identification mark was then made on each sample.

2.2 Standard Penetration Test

The standard penetration tests were conducted in each bore as per IS: 2131: 1981 (Reaffirmed 1987). The split spoon sampler resting on the bottom of bore hole was allowed to sink under its own weight, then the split spoon sampler was seated 15 cm with the blows of hammer falling through 750mm. The driving assembly consists of a driving head and a 63.5 kg weight. It was ensured that the energy of the falling weight is not reduced by friction between the drive weight and the guides or between ropes. The rods to which the sampler was attached for driving were straight, tightly coupled and straight in alignment. Thereafter the split spoon sampler was further driven by 30cm. The number of blows required to drive each 15cm penetration was recorded. The first 15cm of drive considered as seating drive. The total blows required for the second and third 15cm penetration is termed as penetration resistance - N value. The N-values for each borehole are given in bore logs attached as Plate 2 to 21.



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2.3 Static Cone Penetration Test

The test was performed as per IS: 4968 (part-3): 1976, Reaffirmed - 1987. The test procedure for determining the static cone and frictional resistances consists of pushing the cone alone through the soil strata to be tested, then the cone and the friction jacket, and finally the entire assembly in sequence and noting the respective resistance in the first two cases. The cone was pushed through a distance in accordance with the design of the equipment and the need for the substrata and the cone resistance noted. Thereafter, the cone and the friction jacket were pushed together for a distance depending upon the design of the cone and friction jacket assembly and the combined value of cone and friction resistance noted. This procedure was repeated continuously up to refusal (10 tonne capacity of equipment).

The equipment was securely anchored to the ground at the test point for obtaining the required reaction. The jack of the driving mechanism was brought to the top most position. The cone-friction jacket assembly was connected to the first sounding rod and the mantle tube. This assembly was positioned over the test point through the mantle tube guide and held vertically. The plunger of the driving mechanism was brought down so as to rest against the protruding sounding rod.

For obtaining the cone resistance, the sounding rod only was pushed. Switching the gear clutch to the slow position, the drive handle was operated at a steady rate of 1 cm/s, approximately so as to advance the cone only to a depth which is possible with the cone assembly available. During this pushing, the mean value of the resistance as indicated by the Bourdon gauges was noted ignoring erratic changes. For finding the combined cone and friction resistance of the soil, the sounding rod was pushed to the extent the cone has been pushed at the rate of 1 cm/s noting the mean resistance on the gauges, ignoring erratic changes. The procedure was repeated after pushing the combined cone friction jacket and mantle tube assembly to the next depth at which the cone and friction resistance values were required. Extension sounding rods and mantle tubes were added after every one metre of pushing as the test proceeds.



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2.4 Plate Load Test

Plate load tests were performed in accordance to IS: 1888 - 1982 (Reaffirmed 1988). A pit at the test level, having width equal to five times the test plate, was excavated upto the test depth, which in our case was 0.5 to 0.6m since the test was to be carried out above watertable as per NLC specifications and subsequent letter. The pit was carefully levelled and cleaned and protected against disturbance or change in natural formation. The reaction was transferred by means of anchors away from the test pit. No support of reaction girder was located within the test pit. The test plate (450 mm x 450 mm) was placed on the level ground, so that the centre of plate coincides with the centre of reaction girder/beam. The hydraulic jack (Cap. 50T) was centrally placed over the test plate with the loading column in between the jack and reaction beam so as to transfer load to the test plate. A minimum seating pressure of 70 g/cm² was applied and removed before the starting of the load test.

The two supports of the reference rod was placed over the firm ground, fixed with two dial gauges resting at diametrically opposite ends of the plates. The dial gauges were so arranged that settlement was measured continuously without any resetting in-between.

The load on soil in cumulative equal increment was applied. The load was applied through hydraulic jack without impact, fluctuation or eccentricity. The settlement was observed for each increment of load at 1.0, 2.25, 4.0, 6.25, 9.0, 16.0, 25.0, and at hourly intervals or to a time when the rate of settlement gets reduced to a value of 0.02 mm/min. The next increment of load was then applied and the observations were recorded. The test was continued till; a settlement of 40mm had occurred.

2.5 Cyclic Plate Load Test

Cyclic plate load test was performed as per the procedure stated in IS: 5249 & IS: 1888 - 1982 (Reaffirmed 1988).



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The load increment was applied through hydraulic jack without impact, fluctuation or eccentricity. The settlement was observed for each increment of load 1.0, 2.25, 4.0, 6.25, 9.0, 16.0, 25.0, and at hourly intervals or to a time when the rate of settlement gets reduced to a value of 0.02 mm/min. The load was then released to zero & rebound was recorded. Then next increment was applied, & again corresponding settlement & rebound recorded.

From the data obtained from cyclic plate load test the elastic rebound of plate corresponding to each intensity of loading was obtained & load versus elastic rebound curve was plotted. The Coefficient of elastic uniform compression C_u is then calculated using following relation.

$C_u = \frac{P}{S_e}$; Where P = Pressure intensity kg/cm^2 , S_e = Elastic rebound in cm, The Coefficient

obtained from the test is then corrected for 10 m^2 area of foundation. Barken (1962) suggested that the values of C_u for the area up to 10 m^2 can be extrapolated as

$$\frac{C_{u_1}}{C_{u_2}} = \sqrt{\frac{A_2}{A_1}}$$

2.5 Block Vibration Test

Block vibration test is conducted for determination of dynamic parameters of the soil for design of machine foundations. The following dynamic parameters of soil are determined using Block vibration test.

- a) Shear modulus (G)
- b) Elastic Modulus (E)
- c) Coefficient of Elastic Uniform Compression (C_u)
- d) Coefficient of Elastic Uniform Shear (C_τ)
- e) Coefficient of Non-Uniform Compression (C_ϕ)
- f) Coefficient of elastic non-uniform shear (C_ψ)
- g) Damping coefficient of soil (ϵ)

The block vibration test was conducted as per the procedure stated in I.S.5249: 1992. A test pit of size of 3.0m x 6.0m was dug up to 0.50m depth since water table at test location was at 0.6m depth and as per I.S. the test shall be carried out above watertable or



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foundation depth whichever is higher. A plain cement concrete block of M-20 grade concrete of size 1.0m x 1.0m and 1.5 m high was casted with the foundation bolt for mounting the oscillator. The concrete block was cured for a period of 15 days before testing.

Test Setup: The forced vibration tests are carried out and the vibrations are generated with the help of Lazan type of mechanical oscillator, which can produce a sinusoidally varying force in vertical direction only with respect to time. The magnitude of the force depends upon the speed of the oscillator. For running the oscillator a speed controlled DC motor is used. The mechanical oscillator and the D.C. motor are mounted on the concrete block and suitable connection between the power supply, speed control unit, DC motor are made.

Vertical Vibration Test: the vertical vibration tests were carried out as per I.S.5249: 1992 (clause. 5.4.1). The acceleration pickup was fixed on the top of the block such that it senses vertical motion of the block. The mechanical oscillator was mounted on the top of the block such that it generates purely vertical sinusoidal vibrations and the line of action of vibration force passes through the centre of gravity of the block. After choosing a suitable value of angle of eccentricity of masses, the oscillator was made to run at constant frequency. The signals of the acceleration pickups are fed into vibration meter to measure the amplitude of the vibration. The frequency of the oscillator was increased in steps up to maximum frequency of exciter and signals were measured. The same procedure was repeated for various values of angle of setting of eccentricity mass. A graph of amplitude versus frequency is plotted for each excitation level to obtain the natural frequency of the soil and the foundation block.

The coefficient of uniform elastic compression is determined using following expression:

$$C_u = \frac{4 \pi f^2 n z M}{A}; \text{ Where } f n z = \text{Natural frequency obtained from graph, } M = \text{Mass of block, exciter and motor; and } A = \text{Contact area of block with the soil.}$$

From the value of C_u obtained for the test block of contact area of 1.0 sqm, the value of C_u for the foundation having contact area 10sqm can be obtained from equation.



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$$Cu_1 = Cu \times \sqrt{1/10}$$

Determination of damping coefficient of Soil: In case of vertical vibration test the value of damping coefficient of soil (ε) can be determined using the relation as shown below:

$$\varepsilon = \frac{f_2 - f_1}{2 f_{nz}}$$

Where f_1 and f_2 are frequencies at which the amplitude is equal to $X_m / \sqrt{2}$

X_m = Maximum amplitude, f_{nz} = Natural frequency obtained from the graph

From the value of Coefficient of elastic uniform compression (C_u) the values of following coefficients can be determined using the relation given in clause no 8.1

- a) Coefficient of Elastic Uniform Compression (C_u)
- b) Coefficient of Elastic Uniform Shear (C_τ)
- c) Coefficient of Non-Uniform Compression (C_ϕ)
- d) Coefficient of elastic non-uniform shear (C_ψ)

$$C_u = 1.5 C_\tau$$

$$C_\phi = 3.46 C_\tau$$

$$C_\psi = 1.5 C_\tau$$

Wave Propagation Test: The wave propagation test was carried out as per I.S.5249:1992 clause: 7 for determination of the Shear Modulus and the Elastic Modulus of soil. The oscillator was mounted on the block such that it generates purely vertical sinusoidal vibrations and the line of action of the vibrating forces passes through the centre of gravity of the concrete block. The oscillator was set to work at constant frequency, which generates Rayleigh (Surface) waves. To measure the wavelength of this wave, one ray was drawn from the centre line of the block in the longitudinal direction. One of the geophones connected to the phase meter is fixed at a distance of 300 mm from the face of the block



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along the ray drawn, such that the sensing axis of the geophone is vertical. Another geophone connected to the phase meter was moved along the ray away from the block keeping the sensing axis of the geophone vertical and recording the phase difference and distances between the geophones until the phase difference of more than 90 degree was met. A curve was plotted between the phase angle and the distance between the geophones. From the curve, the distance 'S' between the geophones for a phase difference of 90° was determined. The same procedure was repeated for various eccentricities of eccentric masses of the oscillator. Using the following relation the Rayleighs Wave length can be calculated in cms.

$$\lambda/4 = S$$

As the Rayleighs wave velocity and the shear wave velocity are nearly equal for soils thus the shear wave velocity can be found using the relation

$$\text{Velocity of shear waves } V_s = \lambda f$$

Where λ = Wave length in cm, S = Distance between geophones having phase difference of 90°, f = Frequency of Vibration, V_s = Velocity of shear Waves.

The shear modulus and the elastic modulus can be determined using the relation:

$$\text{The shear Modulus (G) = } V_s^2 \times \rho$$

$$\text{The Elastic Modulus (E) = } 2 \times G (1 + \epsilon)$$

Where, ρ = Mass density of soil in $\text{Kg sec}^2 / \text{m}^4$

ϵ = Poisson's ratio of soil. Value assumed as 0.4

2.6 Cross-hole Test

The general principle of the cross-hole test is to establish the shear wave (S-wave) and compression wave (P-wave) velocities of the soil and rock layer at selected depths. The



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waves are generated in an "impulse" borehole and are detected by the geophones in "receiver" borehole drilled at known distance from the impulse borehole.

Three number of bore holes were drilled in straight line at a spacing of 3m intervals. The source bore was inserted with casing of 100mm diameter while other two source holes, casing of 90mm was inserted as per the specifications of the instrument used. The tests were carried out at 3m interval upto 26m depth. The tests below 27m depth was not possible due to squeezing of source hole. For conducting the test, the hammer and geophone were lowered to the test depth. The cables were marked with 1 m depth interval to ensure that the geophone and the hammer are at the same depth. The hammer was secured in this elevation by inflating the rubber tubes provided at the side of the hammer using air pressure. Similarly the geophones were lowered in the receiving holes and secured at the same elevation as that of hammer in the same manner. The tests were started by pulling the strike rode up with the help of string and then allowing it to fall under its own weight. The signals were enhanced by stacking which were achieved by repeating the process. Striking at least five to ten times stacked the waves. The procedures were repeated at each test depth.

2.7 Field Permeability Test

The test was carried out as by constant head method as per the prosedure stated in I.S. 5529 1985. A hole of 100mm diameter was drilled up to test depth and casing is sunk by drilling and driving. The hole was then cleaned by means of scooping spoons and bailer. The hole was kept full of water while cleaning. The test was started by allowing clean water in the bore through metering system to maintain gravity flow at constant head. The flow is adjusted by the regulating valve to obtain steady water level in borehole. When the rate of flow becomes more or less constant, the rate of inflow was recorded.

Permeability (k) = $\left(\frac{Q}{5.5 \times r \times H} \right)$, Where k = coefficient of permeability, Q = constant rate of

flow into the hole, r = internal radius of casing, H = Differential head of water H (Gravity head) – H_f (Head loss due to friction). When k is measured in cm/s, Q in litre/min and H in



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metre, above equation may be written as $Permeability (k) = C_1 \times \frac{Q}{H}$, where C_1 is constant and its value is 6.06×10^{-3} for 100mm diameter casing pipe.

2.8 Field Vane Shear Test :

The field vane shear test is for very soft purely clayey soils which get disturbed during sampling. Such type of purely clayey soft soil was not encountered during investigation hence this test was not conducted.

The summary of fieldwork carried out is given in Table - 1 here under:

Table: 1 Summary of Fieldwork

Bore Hole No	Co-ordinate		R. L. (m)	Depth (m)	No. of SPT	No. of UDS	No. of Core	Water table below GL (m)
BH-1	745W	528S	1.91	15.0	6	2	7	0.35
BH-2	778W	285S	2.29	12.0	7	-	5	0.46
BH-3	685W	664S	1.64	20.0	10	2	12	0.35
BH-4	592W	585S	2.05	14.0	7	2	6	0.49
BH-5	520W	421S	1.46	12.0	7	2	5	0.20
BH-6	517W	121S	1.76	12.0	6	2	5	1.10
BH-7	420W	657S	1.53	14.0	7	2	6	0.20
BH-8	360W	342S	1.92	14.0	6	2	6	0.34
BH-9	360W	482S	1.48	13.5	7	2	6	0.33
BH-10	325W	242S	1.96	8.5	7	-	2	0.71
BH-11	182W	500S	1.84	14.0	9	-	5	0.18
BH-12	50W	489S	2.11	14.0	8	1	5	0.22
BH-13	25E	342S	2.74	15.0	7	2	5	0.20



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Bore Hole No	Co-ordinate		R. L. (m)	Depth (m)	No. of SPT	No. of UDS	No. of Core	Water table below GL (m)
BH-14	145E	589S	2.10	15.0	6	2	5	0.25
BH-15	350E	410S	2.77	15.0	8	-	5	0.40
BH-16	680E	353S	2.34	13.0	7	-	5	0.40
BH-17	725E	550S	2.45	15.0	7	2	5	0.21
BH-18	990E	435S	2.22	12.5	8	-	5	0.25
BH-19	1310E	360S	2.40	14.0	7	2	5	0.19
BH-20	1265E	595S	1.69	13.0	7	-	5	0.70
TP-1	875W	625S	1.18	---	---	3	---	0.75
TP-2	810W	150S	2.24	---	---	3	---	0.45
TP-3	530W	335S	2.13	---	---	3	---	0.45
TP-4	530W	675S	3.87	---	---	3	---	2.0
TP-5	225W	590S	2.23	---	---	3	---	0.2
TP-6	170W	360S	2.85	---	---	3	---	0.3
TP-7	330E	575S	2.52	---	---	3	---	0.3
TP-8	565E	325S	2.21	---	---	3	---	0.25
TP-9	585E	615S	1.89	---	---	3	---	0.20
TP-10	1495E	375S	2.25	---	---	3	---	0.60
SCPT-1	753W	678S	1.70	6.0	---	---	---	---
SCPT-2	660W	482S	1.81	5.6	---	---	---	---
SCPT-3	467W	492S	1.85	6.2	---	---	---	---
SCPT-4	260W	510S	2.62	6.0	---	---	---	---
SCPT-5	430E	410S	2.65	6.4	---	---	---	---



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Bore Hole No	Co-ordinate		R. L. (m)	Depth (m)	No. of SPT	No. of UDS	No. of Core	Water table below GL (m)
SCPT-6	370W	670S	1.60	6.6	---	---	---	---
SCPT-7	360W	495S	1.52	6.6	---	---	---	---
CPLT-1	670W	470S	1.74	0.50	---	1	---	0.6
PLT-1	750W	660S	1.56	0.50	---	1	---	0.5
PLT-2	530W	525S	1.86	0.50	---	1	---	0.5
PLT-3	15E	517S	2.31	0.60	---	1	---	0.6
PLT-4	885E	520S	1.99	0.60	---	1	---	0.65
BVT-1	675W	540S	1.91	0.50	---	1	---	0.6
BVT-2	440W	460S	1.82	0.50	---	1	---	0.7
CBHT-1	500W	430S	1.62	---	---	---	---	---
FPT-1	745W	530S	1.90	2.75	---	---	---	0.35
FPT-2	25E	340S	2.74	2.30	---	---	---	0.20
FPT-3	145E	592S	2.10	3.0	---	---	---	0.19
FPT-4	1310E	368S	2.40	2.25	---	---	---	0.25

BH- Borehole, TP – Trial pit, SCPT – Static cone penetration test, CPLT – Cyclic Plate Load test,
CBHT – Cross Bore Hole Test, BVT – Block vibration test, FPT – Field Permeability test.



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3.0 LABORATORY TEST

The laboratory tests on soil and rock samples were started immediately after the receipt of the same in the laboratory. Following laboratory tests are carried out to determine the physical and engineering properties of undisturbed and disturbed soil samples and rock samples.

1. Dry density and moisture content (IS 2720 part – 2 & 29)
2. Particle size analysis – (IS 2720 part – 4 1985)
3. Atterberg's limit - (IS 2720 part – 5 1985)
4. Specific gravity - (IS 2720 part – 3/sec2 1980)
5. Shear test - (IS 2720 part – 11 1986)
6. Consolidation test – (IS 2720 part – 15 1986)
7. Standard Proctor test – (IS 2720 part 7, 1980)
8. Chemical analysis of soil and water- (IS 2720 part –26 1986 & 27 1977)

All laboratory tests are carried out as per the respective Indian Standards.

3.1 Field Dry Density & Natural Moisture Content

The weight of undisturbed soil sample with sampler (Shelby tube) is determined after removing paraffin wax and loose soil. The total length of soil sample recovery was determined after deducting empty length from the total length of sampler. The volume of soil mass retained in sampler is thus determined from the known inside diameter of sampler and total length of soil mass. The soil mass was then removed and the average moisture content was determined by keeping the soil sample along with crucible in oven at 100-105 degree centigrade for 24 hours. The empty weight of the sampler was then found out. From the total weight of sampler with soil mass, the weight of empty sampler was deducted. The field density is then found out as



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$$\text{Field density (bulk)} = \frac{\text{weight of soil mass}}{\text{volume of soil mass}}; \text{ and, Field dry density} = \frac{\text{Field bulk density}}{1 + w}$$

Where w is water content.

3.2 Particle Size Analysis

The sieve analysis is carried out in accordance with IS: 2720 (Pt.IV). The results are presented in the form of Grain size distribution curve.

Representative soil sample is obtained from the bulk soil sample collected or received from site by method of coning and quartering. Quantity of soil taken will be dependent on the maximum size of particle size present in the soil. Sieve analysis is conducted in two parts:

Soil fraction retained on 4.75mm ISS: Soil portion retained on 4.75 ISS is weighed. The sample is then separated into various fractions by sieving through the following sieves: 100, 75, 19 and 4.75 mm ISS

While sieving through each sieve, sieve is agitated so that sample rolls in irregular motion over the sieve, at no time the particles are pushed through; Care is also taken to see that no individual soil particles are broken, though particles adhering one another are rubbed by rubber pestle when required. Care is also taken not to over load the sieve beyond the permitted maximum load for respective sieve. The mass of the material retained on each sieve is recorded. The percentage of soil retained on each sieve is then calculated on the basis of the total mass of soil taken and from these results, the percentage passing through each sieve is calculated.

Soil fraction passing 4.75 ISS: The portion of the soil passing 4.75 mm ISS is oven dried at 105 to 110 c. The portion is coned & quartered to obtain required representative quantity of the material. The material is weighed and placed in tray/bucket filled with water for soaking and loosening the adhered cohesive materials. The soaked soil specimen is then washed on 75 micron IS Sieve until the water passing the sieve is almost clear. The material retained on 75 micron IS Sieve is then transferred in a tray, dried in oven.



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Sieve analysis is then conducted on a nest of sieves (viz. 2 mm, 425 and 75 micron ISS) either by hand or by using mechanical sieve shaker. The fraction retained on each of the sieves is weighed separately and masses recorded. Cumulative mass of soil fraction retained on each sieve is then calculated. The weights are then converted into cumulative percentage retained and passing on the basis of the mass of the sample passing 4.75 ISS taken. The combined gradation on the basis of the total sample taken for analysis is finally calculated.

3.3 Atterberg's Limit

Liquid and plastic limits are determined by using procedure given in IS: 2720 (Pt-V). The results are given in result sheet. The weight of cone plus rod and plate is 148 gm. A soil sample weighing about 150gm from the thoroughly mixed portion of soil passing 425 micron was used for testing. The thoroughly wet soil paste is transferred to the cylindrical trough 150mm diameter and 50mm high of the cone penetrometer apparatus and levelled up to the top of trough. The penetrometer is adjusted such that the cone point just touches the surface of the soil paste in trough. The scale of the penetrometer is adjusted to zero and the vertical rod is released so that the cone is allowed to penetrate into the soil paste under its own weight. The penetration is noted after 30 sec. from the release of the cone. The reading is considered if the penetration reading is between 20mm and 30 mm. The moisture content of the soil paste corresponding to this is determined. The liquid limit of the soil which corresponds to the moisture content of a paste which would give 25 mm penetration of the cone is determined using formula:

$$W_{LL} = W_x + 0.01 (25 - W) (W_x + 15)$$

For determination of plastic limit, a soil sample weighing at least 20 gm from the soil sample passing 425micron IS sieve is thoroughly mixed with water such that it can be easily moulded with fingers. A ball is formed with about 8 to 10 gm of this soil & is rolled between the fingers and the glass plate with just sufficient pressure to roll the mass into a thread of uniform diameter of 3mm throughout its length. The soil is then kneaded together to a uniform mass and rolled again. The process is continued until the thread crumbles.



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The pieces of crumbled soil thread are collected and moisture content is determined and reported as plastic limit.

3.4 Specific Gravity

The specific gravity of soil solids is determined by a 50ml density bottle. The weight (W_1) of the empty dry bottle is taken first. A sample of oven-dried soil about 10-20 g cooled in a desiccator, is put in the bottle, and weight (W_2) of the bottle and the soil is taken. The bottle is then filled with distilled water gradually removing the entrapped air either by applying vacuum or by shaking the bottle. The weight (W_3) of the bottle, soil and water (full up to the top) is then taken. Finally the bottle is emptied completely and thoroughly washed and clean water is filled to the top and the weight (W_4) is taken.

$$\text{Specific Gravity (G)} = \frac{(W_2 - W_1)}{(W_2 - W_1) - (W_3 - W_4)}$$

3.5 Shear Test

Triaxial (undrained) tests are carried out to determine the shear parameters. The shear tests are carried out in accordance with IS: 2720 (pt. X, XI, XII and XIII) on saturated samples. For unconsolidated undrained triaxial compression test, the undisturbed soil specimen having diameter 38 mm and height to diameter ratio 2 is prepared and placed on the pedestal of the triaxial cell. The cell is then assembled with the loading ram and then placed in the loading machine. The cell fluid is admitted to the cell and the pressure is raised to the desired value. An initial reading of the gauge measuring axial compression of the specimen is recorded. The test is then commenced and sufficient number of simultaneous readings of load and compression measuring gauge being taken. The test is continued until the maximum value of the stress has been passed or until an axial strain of 20 per cent has been reached. Additional tests are carried out on identical specimen at confining pressure of 1 kg/cm², 2 kg/cm² and 3 kg/cm². The shear parameters are obtained from the plot of Mohr circles.



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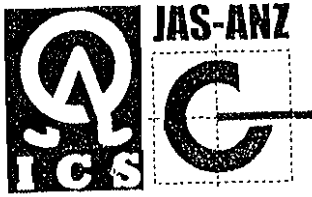
Direct shear test is carried out using shear box with the specimens (60mmx60mm). Specimen with plain grid plate at the bottom of the specimen and plain grid plate at the top of the specimen is fitted into position in the shear box housing and assembly placed on the load frame. The serrations of the grid plates are kept at right angle to the direction of shear. The loading pad is kept on the top grid plate. The required normal stress is applied and the rate of longitudinal displacement/shear stress application so adjusted that no drainage can occur in the sample during the test (1.25mm/min). The upper part of the shear box is raised such that a gap of about 1mm is left between the two parts of the box. The test is conducted by applying horizontal shear load to failure or to 20 percent longitudinal displacement whichever occurs first. The test is repeated on identical specimens.

3.6 Consolidation Test

The consolidation tests were carried out on undisturbed soil specimen in order to determine the settlement characteristics of soil at different depths. The tests were conducted in accordance to IS: 2720 (Pt-XV).

An undisturbed soil specimen is extruded to the consolidation ring of 60mm diameter. The edge is trimmed carefully such that the sample flushes with the top and bottom edges of the ring. The thickness of the specimen is measured and the weight is recorded. The bottom porous stone is then centred on the base of the consolidation cell.

The specimen is placed centrally between the bottom porous stone and the upper porous stone. A filter paper is provided in-between specimen and porous stones. Then the loading cap is placed on the top. The consolidometer is placed in position in the loading device and suitably adjusted. The dial gauge is then clamped into position for recording the relative movement between the base of the cell and the loading cap. A seating pressure of 0.05 kg/cm² is applied to the specimen. The cell is kept filled with water. After 24 hours the test is continued using a loading sequence on the soil specimen of 0.25, 0.5, 1.0, 2.0, 4.0, and 8.0 kg/cm². For each loading increment after application of load, readings of the dial



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gauge is taken using time sequence 0, 0.25, 1, 2.25, 2, 6.25, 9, 16, 25, 36, 49 ... up to 24 hrs. From the observations of all incremental pressure, void ratio versus log (pressure) curve is obtained. The slope of the straight line portion is designated as compression index c_c .

3.7 Standard Proctor Test

The test is conducted in accordance to IS: 2720 (pt-7) 1980 to determine the moisture content relationship. A 5 kg air dried soil passing 20 mm IS sieve is taken and thoroughly mixed. The mould with base attached is weighed to the nearest 1 g. The soil is then moistened by adding 8 to 10 per cent water and compacted in to the mould in three equal layers. Each layer is being compacted by 25 blows of 2.6 kg rammer dropped from a height of 310 mm. The blows are distributed uniformly over the surface of each layer. The extension collar is removed, soil is trimmed and mould with base plate is then weighed to nearest 1 g. The compacted soil specimen is removed and moisture content is determined. The process is repeated by adding more water of about 2 per cent of dry soil till the density of sample decreases. The curve in-between dry density and moisture content is plotted and maximum dry density and corresponding optimum moisture content is reported.

3.8 Chemical Analysis

pH value, Sulphate and chloride contents of soil and ground water are determined.

pH Value (IS 2720 Pt.264 - 1987): A 30 gm of the soil passing 425 micron IS sieve is taken in a 100 ml beaker. 75 ml of distilled water is added to it and then stirred. The pH Value is then measured using pre-calibrated pH meter.

Sulphate: To determine soluble sulphate (IS 2720 Pt 27) 10gm of soil sample is placed in a 250 ml bottle allowed to stand overnight frequently stirred. Filter and 25 ml of filtrate in a beaker is taken and added concentrated hydraulic acid to just neutralize the solution if it is found alkaline. More acid is added to make the solution acidic. Solution is then boiled. Barium chloride solution is then added in the stream with constant stirring till there is no precipitation with further addition. Beaker is then placed on the steam bath for a



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minimum period of 4 hour and precipitates are allowed to settle. Precipitates are then filtered through ash less filter paper, dry and ignited & Cooled in the desiccator, weighed and noted the weight of the residue. This is the weight of barium sulphate. A corresponding weight of sodium sulphate is calculated and its percentage is determined.

The chemical analysis of water is done as per IS 3025 - 1964.

Sulphate in the sample are precipitated by barium chloride and precipitate weighed as barium sulphate and reported as sulphate in mg/lit.

Chloride: The sample after neutralisation is titrated against standard silver nitrate solution using potassium chromate indicator. 100 ml of the sample is taken and 1 ml of potassium chromate indicator is added. It is then titrated against standard silver nitrate solution with constant stirring until there is perceptible reddish coloration. Chlorides (as Cl) is then calculated and reported in mg/lit.

The following laboratory tests are carried out on rocky samples and the tests are briefly described as below.

1. Classification of rock
2. Water absorption
3. Bulk density
4. Uniaxial compressive strength

All the laboratory tests are carried out as per relevant IS Codes. The procedure is briefly described as below :

3.1.1 Water Absorption

a) This method of test covers the procedure for determining the water absorption of rock sample in form of lumps of irregular shape-geometry and the rock which do not swell or disintegrate when immersed in water & oven dried.



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- b) A representative sample comprising of least min. 10 lumps of irregular geometry each of about 50 g or a min. dimension of atleast 10 times the max. grain size, whichever is greater is selected. The sample is washed in water to remove loose particles. The sample is saturated in water immersion vessels & entrapped air is removed by gentle agitation.
- c) The vessels is then emptied & the sample is allowed to drain to become surface dried. The sample is then weighed (B). The sample is then dried in oven at 100 to 110 degree centigrade for not less than 24 hours. It is then cooled to room temperature & weighed (A). The water absorption is calculated from the following formula :

$$B - A$$

Water absorption = ----- x 100 , percent

$$A$$

3.1.2 Bulk Density of Rock sample

The procedure given for water absorption test in sub para (a) is followed :

- a) The saturated sample is then carefully introduced in a water displacement vessel to measure volume of sample. This vessel is siphon type. Water equal to the rock sample gets displaced by over flowing under siphon action and thereby volume of rock sample is determined. (V)

The bulk density is then determined by following formula.

Bulk dry density = w/v , g/cc

Uniaxial Compressive Strength

This test is conducted on the core samples having length about 1.5 to 2.0 times the diameter of the sample on the universal compression-testing machine. For carrying out this test and analysis of the test provisions of IS: 9143: 1979 has been adopted.



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4.0 SUB SOIL STRATIFICATION

Field and laboratory test data reveal in general that the sub soil strata are poorly graded fine silty sand up to about 5.0m to 6.0m depth. Below that there is a layer of weathered calcareous limestone having thickness of about 2.0m. Below that and up to the depth investigated, the calcareous lime stone is available. There is no much variation in sub strata, however there is a presence of about 1.0m to 3.0m thick clayey silt pocket nearby borehole BH-1 and BH-8 at about 3.0m to 4.0m depth from the existing ground level. Plate 27 to 28 shows the generalised cross sectional profile of the sub strata along North – South and East – West direction.

The rock core obtained from each borehole during drilling operation was examined and its detail geological description was given in the form of Table attached as Plate 29.

5.0 DISCUSSION ON FIELD AND LABORATORY TEST RESULTS

5.1 Field Test

5.1.1 Standard Penetration Test

A comparative study of observed N value (i.e. number of blows /30cm penetration) has been done for all the boreholes. The SPT N values for individual borehole are given in Plate 2 to 21. The depth wise SPT – N value (observed) in different boreholes is shown in Table 2. The SPT-N values (observed) are in the range of 5 to more than 50 in sandy stratum. This range values indicates loose to dense silty sandy stratum. From the SPT – N values variation it infers that the sub stratum up to about 1.0m depth and in between 4.0m to 5.0m depth is loose to medium in nature at many locations. The SPT – N value below 6.0m depth is further increases to more than 50 indicating dense sandy stratum in all the boreholes with few exceptional values. The SPT – N values in weathered rock shows more than 100 in all the boreholes. The SPT-N values variation in each borehole is shown in bore logs attached as Plate 2 to 21.

5.1.2 Static Cone Penetration Test (SCPT)

Seven SCPT were conducted at location shown in location map (Plate - 1). The tests are conducted up to 6.0m to 7.0m depth as per procedure shown above. The observation table along with graphs of depth versus cone penetration resistance (qc) in kg/cm² are shown in Plate 30 to 36. The observed value is corrected and the average value of qc at each location is determined between the level of the base of footing (assumed as 1.50m depth below existing GL) and the depth equal to 1.5 to 2 times the width of the footing (assumed as 1.0m). The weighted average of the qc values is determined for each location and minimum of the average values is used for the further computation.

From plot of depth versus cone penetration resistance (Plate 30 to 36), it infers in general that the cone resistance value is very low in upper 1.0m depth and in between 4.0m to 6.0m depth in all the tests. The cone resistance value increases in between depth of about 1.0m to 4.0m. The weighted average cone penetration resistance within the average influence zone for shallow foundation (assumed as 1.50m to 4.0m depth below ground level) from the various tests are works out as shown in Table 3 below:

Table 3: Weighted Average Cone Resistance Value

Test	Weighted Average Cone resistance (kg/cm ²)
SCPT1	32.75
SCPT2	31.15
SCPT3	42.45
SCPT4	74.58
SCPT5	80.27
SCPT6	59.53
SCPT7	51.94

The minimum average cone resistance value is 31.15 kg/cm², and therefore it is selected for further computation.



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As per IS Code (IS: 6403), let $q_{ult-net} / q_c \approx 0.13$ (For $B = 1.0m$)

Therefore, $q_{ult-net} = 0.13 \times 31.15 = 4.0495 \text{ kg/cm}^2$.

$q_{net-safe} = q_{ult-net} / \text{FOS (3)} = 4.0495 / 3 = 1.349 \text{ kg/cm}^2$, say 13.49 t/m^2 .

Settlement can be computed using Meyerhof's approach as shown below:

$$q_{safe-pr} = 0.392 q_c \left(\frac{B+0.3}{B} \right)^2 \text{ (For 25mm settlement).}$$

where $q_c = 31.15 \text{ kg/cm}^2$, and $B = \text{width of footing}$.

Thus for 1m width, $q_{safe-pr} = 0.392 \times 31.15 \left(\frac{1+0.3}{1} \right)^2 = 20.64 \text{ t/m}^2$ for 25 mm settlement.

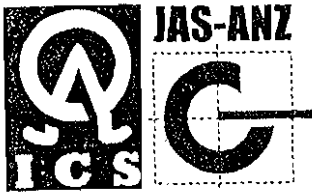
5.1.3 Plate Load Test

Plate 37 to 40 shows the load settlement curve of plate load test conducted at 0.5m to 0.6m depth using 45 x 45 cm size of plate. The general nature of the load settlement curve is interpolation type shear failure, except in load test no. 2, where local shear type of failure was observed. Load test no. PLT-1 to PLT-4 shows net safe bearing capacity as shown in Table 4 below:

Table 4: Summaries of Plate Load Test Results

Test	Location	RL of test	Depth (m)	Net safe bearing
PLT1	750W, 660S	1.56	0.5	2.0
PLT2	530W, 525S	1.86	0.5	1.12
PLT3	15E, 517S	2.31	0.6	19.6
PLT4	885E, 520S	1.99	0.6	5.2

The net safe bearing capacity is evaluated from the graph by drawing tangent lines as shown on load settlement curves attached as plate 37 to 40.



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5.1.4 Cyclic Plate Load Test

Plate - 41 shows load settlement curve of cyclic plate load test conducted at 0.5 m depth below existing ground level using 45 cm x 45 cm plate size. From each loading - unloading cycle, elastic rebound was determined and a plot of load versus elastic rebound was generated as shown in Plate 41. The slope of load intensity - settlement plot is the coefficient of elastic uniform compression (C_u). $C_u = P/Se \text{ kg/cm}^3$

Where P = Load intensity in kg/cm^2 , and Se = Elastic rebound corresponding to P in cm.

The C_u varies with the contact area of the base. Hence, the value of C_u obtained from the test needs a correction due to contact area. Barken (1962) suggested that the values of C_u for the area up to 10m^2 can be extrapolated as $\frac{C_{u_1}}{C_{u_2}} = \sqrt{\frac{A_2}{A_1}}$. The C_u value evaluated from cyclic plate load test for foundation area of 10 sq m is 0.268 kg/cm^3 .

Compression index C_u , the coefficient of elastic uniform shear C_τ , the coefficient of elastic non uniform compression C_ϕ , and the coefficient of elastic non uniform shear C_ψ are related to each other by the relation given below (Ref. IS: 5249 – 1992) :

$$C_u = 1.5 \text{ to } 2 C_\tau$$

$$C_\phi = 3.46 C_\tau$$

$$C_\psi = 1.5 C_\tau$$

$$\text{Therefore } C_\tau = 0.134 \text{ to } 0.179 \text{ kg/cm}^3$$

$$C_\phi = 0.464 \text{ to } 0.619 \text{ kg/cm}^3$$

$$C_\psi = 0.201 \text{ to } 0.269 \text{ kg/cm}^3$$

5.1.5 Block Vibration Test

Two block vibration tests are carried out in a test block of size $1.0\text{m} \times 1.0\text{m} \times 1.5\text{m}$. Both wave propagation and vertical vibration tests are carried out at both the places. Plate 42 and 43 shows test observation along with graphs and computation of dynamic parameters for both the tests. The computation of dynamic parameters are shown in Plate 42 and 43 for test 1 and test 2 respectively. For test 1 (BVT1), the dynamic parameters C_u , C_τ , C_ϕ , and



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C_{ψ} are 4.97kg/cm^3 , 2.49kg/cm^3 , 8.60kg/cm^3 , and 3.73kg/cm^3 respectively. While for test 2(BVT2), C_u , C_{τ} , C_{ϕ} , and C_{ψ} are 5.22kg/cm^3 , 2.61kg/cm^3 , 9.03kg/cm^3 , and 3.92kg/cm^3 respectively.

5.1.6 Cross-hole Test

From the recorded first arrivals of P wave (t_p) and S wave (t_s) various dynamic parameters are determined as shown in Plate 44. The summary of dynamic parameter as obtained from the test is shown in Table 5 here under.

Table 5: Summary of Dynamic Parameters

Depth (m)	Soil Type	Unit weight (kN/m^3)	Dynamic Shear Modulus (G), MPa	Dynamic Young's Modulus (E), MPa	Poisson's ratio
Location: Test bore-1, Distance: 2.97m					
3	Fine Sand	17	164	422	0.29
6	Clayey Sand	18	189	506	0.34
9	Weathered Rock	20	415	1082	0.30
12	Weathered Rock	20	419	1083	0.29
15	Weathered Rock	20	460	1179	0.28
18	Weathered Rock	20	460	1143	0.24
21	Weathered Rock	20	432	1081	0.25
24	Weathered Rock	20	652	1641	0.26
26	Weathered Rock	20	628	1567	0.25
Location: test bore 2, Distance: 6.03m					
3	Fine Sand	17	156	404	0.29
6	Clayey Sand	18	204	541	0.33
9	Weathered Rock	20	407	1062	0.31

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Depth (m)	Soil Type	Unit weight (kN/m ³)	Dynamic Shear Modulus (G), MPa	Dynamic Young's Modulus (E), MPa	Poisson's ratio
12	Weathered Rock	20	439	1137	0.30
15	Weathered Rock	20	456	1175	0.29
18	Weathered Rock	20	449	1112	0.24
21	Weathered Rock	20	425	1061	0.25
24	Weathered Rock	20	713	1770	0.24
26	Weathered Rock	20	699	1734	0.24

5.1.7 Field Permeability Test

Four in-situ permeability tests were carried out using constant head method as discussed above. The observation table along with calculation is shown in Plate 45 to 48. The in-situ permeability values for different tests are as shown in Table 6 below:

Table 6: Summaries of Field Permeability Tests

Test No	Location	Type of Soil	Depth of Test (m)	Permeability (cm/s)
FPT1	745W, 530S	Silty fine sand	2.75	2.58x10 ⁻⁵
FPT2	25E, 340S	Silty fine sand	2.30	1.67x10 ⁻⁵
FPT3	145E, 592S	Fine sand	2.25	1.38x10 ⁻⁴
FPT4	1310E, 368S	Yellow fine sand	3.0	1.15x10 ⁻⁴

5.2 Laboratory Test

The detail result sheets are attached as Plate 49 for soil test results and Plate 50 for rock test results..



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5.2.1 Field Density - Field Moisture Content

Field dry density and moisture content vary with depth. The dry density varies in the range of 1.21g/cc to 1.67g/cc with average value of 1.46g/cc. the moisture content is in the range of 7 percent to more than 50 percent at certain locations. Silty clayey stratum shows higher moisture content compare to sandy stratum. This higher moisture content is due to high water table in the vicinity.

5.2.2 Particle Size Analysis

Plate 51 to 67 shows the gradation curves of the various soil samples. Silty clayey soil shows more than 50 percent fines in almost all the results. The silty sandy strata show more than 50 percent presence of sand particles. The detail results are tabulated in results sheets attached as plate 49.

5.2.3 Atterberg's Limit

Silty clayey layer shows liquid limit, plastic limit and plasticity index in the range of 26% to 84%; 24% to 46%; and 9% to 47% respectively. Silty sandy layer shows non-plastic behaviour.

The soil is classified as per I. S. Classification system using sieve analysis and Atterberg's limit results as shown in result sheet attached as Plate 49.

5.2.4 Specific Gravity

The values are given in result sheet attached as Plate 49. The general range of specific gravity for all the three layers is in-between 2.52 to 2.66 with some exceptional values.

5.2.5 Direct Shear Test

Triaxial shear (uu) test are performed on silty-clayey soil samples, while direct shear tests are conducted for silty-sandy soil of samples. Triaxial shear test shows the cohesion value in the range of 0.25 kg/cm² to 0.40 kg/cm² with some exceptional high and low values.

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Samples show angle of internal friction in the range of 0 to 4 degrees. Samples are tested after saturation.

Direct shear test on silty -sandy stratum shows no cohesion with angle of internal friction in the range of 25 to 32 degree.

Plate 68 to 99 shows the failure envelopes for direct shear test and triaxial shear test.

5.2.6 Consolidation Test

Consolidation tests were conducted on various soil samples collected from different bore holes at various depths. The results of consolidation tests of various soil samples are shown in result sheets attached as Plate 49. Test result shows C_c value in the range of 0.07 to 0.23 with pre-compression pressure in the range of 0.55 kg/cm^2 to 1.30 kg/cm^2 (Plate 100 to 109). The ' m_v ' parameters for the pressure range of $2\text{-}4 \text{ kg/cm}^2$ are in the range of $0.0057 \text{ cm}^2/\text{kg}$ to $0.0254 \text{ cm}^2/\text{kg}$.

5.2.7 Standard Proctor

Plate 110 to 119 shows Standard Proctor test curves. The test results obtained are as shown in Table 7.

Table – 7 Standard Proctor Test

Location	Depth (m)	Std. Proctor Test	
		MDD (g/cc)	OMC (%)
BH-3	0.5	1.44	22.1
BH-4	0.5	1.62	12.5
BH-5	0.5	1.66	14.0
BH-6	0.5	1.65	8.0
BH-7	0.5	1.53	16.0

Location	Depth (m)	Std. Proctor Test	
		MDD (g/cc)	OMC (%)
BH-8	0.5	1.58	14.0
BH-16	2.0	1.50	11.0
BH-17	1.0	1.60	15.2
BH-20	0.5	1.61	12.0
BH-20	2.0	1.52	17.0

5.2.8 Chemical Analysis

Results of chemical analysis of various soil and water samples are presented in Table-8 and 9.

Table - 8 Chemical Analysis of Soil

Borehole No	Depth (m)	pH	Chloride (%)	Sulphate (%)	
				SO ₃ (2 Water: 1Soil)	SO ₃ (10 Water: 1 soil)
BH-1	0.5	7.9	4.0	3.00	1.31
BH-2	2.0	7.8	4.5	3.31	1.39
BH-4	4.0	7.8	4.2	3.45	1.39
BH-7	3.0	8.0	4.8	3.80	1.64
BH-9	1.0	7.9	5.0	3.40	1.48
BH-10	0.5	8.2	4.4	3.13	1.31
BH-11	2.0	8.0	4.2	3.72	1.49
BH-14	3.0	7.8	3.8	3.64	1.43
BH-16	2.0	7.7	4.0	3.60	1.44
BH-18	3.0	7.8	4.5	3.72	1.39

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Table – 9 Chemical Analysis of Water

Bore hole No	pH	Chloride (mg/l)	Sulphate SO ₃ (mg/l)
BH-1	7.4	5000	1639
BH-2	7.2	6000	1721
BH-4	7.2	6500	1967
BH-7	7.4	7000	2131
BH-9	7.2	6820	1967
BH-11	7.2	7200	1639
BH-13	7.7	5700	1800
BH-15	7.5	6000	2295
BH-17	7.5	6500	3459
BH-19	7.4	7000	2787

Soil and water sample shows high concentration of sulphate, and hence precautions against sulphate attack is necessary. As per IS 456: 2000, Supersulphated or sulphate resisting Portland cement is recommended. Minimum cement content shall be 370 kg/m³ and maximum Face Water – Cement ratio shall be 0.45. Also, as ground water samples shows high concentration of sulphate and chloride, it is not suitable to use for construction purpose.

5.2.9 Rock Test Results

The rock samples as obtained from the different boreholes in the form of rock cores are further tested in the laboratory for compressive strength. The rock at the site is calcareous sand stone and its compressive strength varies in the range of 40 kg/cm² to 160 kg/cm², water absorption varies from 0.7% to 3.0% and specific gravity varies from 2.34 to 2.70 with



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some exceptional high and low values. This variation is due to extent of weathering effect and mode of formation of rock at the site. The bore wise detail test results are shown in Plate 50.

6.0 SOIL BEARING CAPACITY

The following formula is used for calculating ultimate net bearing capacity in the case of strip footings: (Ref: IS: 6403 - 1981)

a) In case of general shear failure:

$$d = C N_c + q (N_q - 1) 0.5 B_r N_r$$

b) In case of local shear failure:

$$d = 2/3 C N'_c + q (N'_q - 1) + 0.5 B_r N'_r$$

The ultimate net bearing capacity obtained for strip footing is modified to take into account, the shape of the footing, inclination of loading, depth of embedment and effect of water table. The modified bearing capacity formula is given as under:

a) In case of general shear failure:

$$Q_a = C N_c S_c d_c i_c + q (N_q - 1) S_q d_q i_q + 0.5 B_r N_r S_r d_r i_r W'$$

b) In case of local shear failure:

$$Q_u' = 2/3 C N'_c S_c d_c i_c + q (N'_q - 1) S_q d_q i_q + 0.5 B_r N'_r S_r d_r i_r W'$$

Shape Factor

	S_c	S_q	S_r
i Continuous strip	1.00	1.00	1.00
ii Rectangular	$1 + 0.2 B/L$	$1 + 0.2 B/L$	$1 - 0.4 B/L$
iii Square	1.3	1.2	0.8
iv Circle	1.3	1.2	0.6



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Depth Factor

$$dc = 1 + 0.2 \frac{D_f}{B} \sqrt{N\phi}, \text{ Where } \sqrt{N\phi} = \left(45 + \frac{\phi}{2} \right)$$

$$dq = dr = 1 \text{ for } \phi < 10 \text{ degree} \quad dq = dr = 1 + 0.1 \frac{D_f}{B} \sqrt{N\phi}, \text{ for } \phi > 10 \text{ degree}$$

In addition to above, the safe bearing capacity is also evaluated using field test as discussed below:

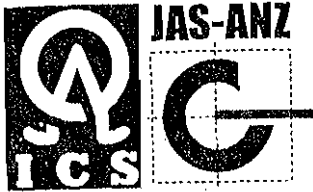
6.1 Design Parameters for Shallow Foundations

6.1.1 Shear and Settlement Criteria

Following parameters are adopted for the evaluation of bearing capacity for shallow foundation.

Parameters	
Cohesion (kg/sq.cm)	0.00
Angle of Internal friction (degree)	28
Dry density (g/cc)	1.46
Bulk density (g/cc)	1.76
Specific Gravity	2.59
Coeff. of volume change, m_v (cm^2/kg)	0.012
Water Table	At G L
Factor of safety	2.5

$$\text{Void ratio, } e = \frac{G\gamma_w}{\gamma_d} - 1 = \frac{2.59 \times 1}{1.46} - 1 = 0.77$$



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Thus, local shear failure was considered for safe bearing capacity computation. The net safe bearing capacity for various sizes of individual rigid footings having vertical static load intensity is evaluated as in Table - 10. The settlement analysis was carried out using Static Cone Resistance value as discussed above in Para 5.1.6.

From the observations of SPT and SCPT results, it reveals that the soil is soft / loose in nature up to top 1.0m and from about 4.0m to 5.0m depth. So, it is recommended to provide foundation depth at 1.0m or 1.5m depth and width of foundation such that pressure bulb remains above soft strata. So if foundation depth is 1.5m and width of foundation is 1.0m, then pressure bulb will remain within the depth of 1.5m to 3.5m. Foundations for heavy load shall be placed on hard stratum, and as rock is available at relatively shallow depth, end bearing pile is suggested.

S B C Calculation (I S 6403)	
Type of Footing	Square Footing
Size (m x m) Depth (m)	1.0 x 1.0 x 1.0
Cohesion (kg/cm ²)	zero
Angle of Internal Friction (Degree)	28
Water Table Consideration	G.L
Shape Factor (Sc, Sq, Sy)	1.30, 1.20, 0.8
Depth Factor (dc, dq, dy)	1.333, 1.166, 1.166
Bearing Capacity Factor N'c, N'q, N'y	14.473, 6.156, 5.099
$q_{ult} = c N'_c S_c d_c i_c + q (N'_q - 1) S_q d_q i_q + 0.5 B_r N'_r S_r d_r i_r w'$	
$q_{ult} = 0 + 0.91 * 1 * (6.156 - 1) * 1.2 * 1.166$	
$+ 0.5 * 1 * 1.91 * 5.099 * 0.8 * 1.166 * 0.5 = 8.84 \text{ t/m}^2$	
Net Safe Bearing Capacity = 8.84 / 2.5 = 3.53 t/m²	
(Factor of Safety = 2.5)	



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Table - 10 shows the summary of SBC and SBP evaluated based on shear and settlement parameters.

Table - 10 Summaries of SBC & SBP

Size (m)	Depth (m)	Safe Bearing Capacity (SBC) (t/m ²)	Safe Bearing Pressure from SCPT (SBP) (t/m ²) for 25mm settlement	Recommended value (t/m ²)
1.0X1.0	1.0	3.54	20.64	3.54
1.0X1.0	1.5	5.2	20.64	5.2
1.5X1.5	1.0	3.8	17.58	3.8
1.5X1.5	1.5	5.3	17.58	5.3

6.1.2 Plate Load Test

Plate – 37 and 40 show load settlement curve for plate load test conducted at 0.5 m depth. Load –settlement curve indicates safe bearing capacity in the range of 1.12t/m² to 5.2t/m² with exceptional values of 19.6t/m² at PLT-3 location. As the soil stratum at test depth of 0.5m is soft / loose in nature which reflects in lower safe bearing capacity.

6.2 Design Parameters for Deep (pile) Foundations

The vertical static load carrying capacity of individual pile is evaluated as end bearing pile resting on rock which is available at about 5.0m to 9.0m depth below existing ground level. However the average rock level available at about 7.0m depth. For piles resting on weathered rock it may be necessary to provide socketing to piles so that they can be loaded to their safe structural capacity. The socket length in such cases is 3 times the diameter of the pile. In this method load capacity is assumed to be derived from point resistance only.



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This assumption can be considered as safe, since the bearing capacity of the rock is available, irrespective of construction procedure. The load carrying capacity of individual pile based on properties of rock cores can be found out using relation $Q_{ap} = A_p q_a$, where $q_a = q_u K_{sp} K_{ap}$, q_u = average unconfined compressive strength of rock core, K_{sp} = empirical factor, known as bearing pressure coefficient which includes FOS of 3 (assumed as 0.25 for wide spacing of discontinuities), K_{ap} = depth factor = $0.8 + 0.2 L/D$ (where L = length of socket in rock and D is diameter of the socket).

Consider average unconfined compressive strength of rock (q_u) up to the depth of 10m equal to 90.4 kg/cm^2 . Let $K_{sp} = 0.25$, and $K_{ap} = 0.8 + 0.2 * (3D/D) = 1.4$. Therefore, $q_a = q_u * K_{sp} * K_{ap} = 90.4 * 0.25 * 1.4 = 31.64 \text{ kg/cm}^2$.

$Q_{ap} = q_{ap} * A_p$. For 45 cm diameter pile, $Q_{ap} = 31,64 * (\pi/4 * 45 * 45) = 50321 \text{ kg (50.32 T)}$.

Table-11 provides load carrying capacity of individual pile subjected to load test verification.

Table - 11 Summaries of Load Capacity of Pile Foundation

Pile Diameter (m)	Socket Length in rock (m)	Pile capacity in Compression (t)
0.45	1.35	50.30
0.5	1.50	62.13
0.6	1.80	89.46



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7.0 RECOMMENDATION

1. Sub soil strata are poorly graded fine silty sand up to about 5.0m to 6.0m depth. Below that there is a layer of weathered calcareous lime stone having thickness of about 2.0m. Below that and up to the depth investigated, the calcareous lime stone is available. There is no much variation in sub strata is observed, however there is a presence of about 1.0m to 3.0m thick clayey silt pocket nearby borehole BH-1 and BH-8 at about 3.0m to 4.0m depth from the existing ground level.
2. The safe bearing capacity considering laboratory shear and settlement parameters is recommended as given in Table – 10 for minor and light loaded foundations. The recommended value of SBC shall be for static vertical loading only. The foundation depth shall be as shown in Table -10.
3. Load –settlement curve indicates safe bearing capacity in the range of 1.12 t/m^2 to 5.2 t/m^2 with exceptional values of 19.6 t/m^2 at PLT-3 location.
4. Table - 11 gives the vertical static load carrying capacity of individual pile for heavy structures. The pile capacities as mentioned in Table - 11 is subjected to a conformation by performing a Pile load test as mentioned in IS: 2911 Part-iv
5. The soil does not show swelling characteristics and is suitable for back filling as well as for road construction purpose.
6. The coefficient of Active and Passive earth pressure shall be considered as 0.36 and 2.77 respectively. This is computed using angle of internal friction value of 28 degree of the sub strata.
7. Soil and water sample shows high concentration of sulphate, and hence a precaution against sulphate attack is necessary. As per IS 456: 2000, Super sulphated or sulphate resisting Portland cement is recommended. Minimum cement content shall be 370 kg/m^3 and maximum Face Water – Cement ratio shall be 0.45. Ground water is not suitable for use in construction purpose.



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8. A Field permeability value varies in the range of 1.15×10^{-4} cm/s to 2.58×10^{-5} cm/s.
9. As the topsoil is sandy in nature and high water table, stability of excavated trench shall be maintained properly by providing strutting wherever necessary.
10. Cross-hole test shows average dynamic parameter as under:

Soil Type	Dynamic Shear Modulus G MPa	Dynamic Young's Modulus E MPa	Poisson's Ratio	Unit weight kN/m ³
Fine sand	160	413	0.29	17
Clayey sand	196.5	523.5	0.335	18
Weathered rock	503.8	1273.4	0.267	20

11. The average dynamic soil parameters as obtained from block vibration test is as under:

Parameters	Test 1	Test 2	Average value
Coefficient of elastic uniform compression (kg/cm ³)	4.97	5.22	5.095
Coefficient of elastic uniform shear (kg/cm ³)	2.49	2.61	2.55
Coefficient of elastic non uniform compression (kg/cm ³)	8.60	9.03	8.81
Coefficient of elastic uniform shear (kg/cm ³)	3.73	3.92	3.83



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Parameters	Test 1	Test 2	Average value
Damping coefficient	0.162	0.329	0.245
Shear Modulus (kg/sq.cm)	276.9	342.9	309.9
Elastic modulus (kg/sq.cm)	775.5	960.0	869.25

For GEOSTRUCT ENGINEERING & TESTING SERVICES

(G. J. TALATI)

Dr. F. S. Umrigar
B.E. M.Tech. Ph.D. FIE
Principal



BIRLA VISHVAKARMA MAHAVIDYALAYA
(ENGINEERING COLLEGE)

P O BOX NO 20 • VALLABH VIDYANAGAR-388 120 • GUJARAT • INDIA
PHONE (02692) 233104, 230762 Fax : 236672
EMAIL bvm.princi@yanco.com
Website : <http://bvmengineering.ac.in>

**VETTING OF SOIL INVESTIGATION REPORT FOR PROPOSED 2 X 500
MW NLC THERMAL POWER STATION AT TUTICORIN**

Investigated by :

Geostruct Engineering & Testing Services
8, Sahajanand Co-op. Industrial Estate
Munjmahuda
BARODA – 390 021

Vetted by :

Dr. A.K.Verma
Professor
Structural Engg.Dept.
Birla Vishvakarma Mahavidyalaya
VALLABH VIDYANAGAR-388120

Submitted on : September,2005



It is found from the soil investigation report that a good number of laboratory tests on soil samples and rock samples have been carried out, which is adequate. The findings of laboratory results match with the Field Tests results such as Static Conc Penetration test, Standard Penetration Test, Plate Load Test, etc.

The dynamic parameters obtained from:

- 1) Block Vibration Test
- 2) Cross Hole Test
- 3) Wave Propagation Test

are quite reliable and are required in the design of machine foundation and vibration analysis.

The overall planning in carrying out the test is quite satisfactory, but the soil conditions upto 6.0 depth are poorly graded sand ($Q_{nsafe} = 3$ to 5 t/m^2) which needs to be improved by resorting to some ground improvement techniques or pile foundation as mentioned in the report.

The report is well documented and tests results are in tune with the soil characteristics.

From the plate 2 to 21 in the report, the borelog shows highly weathered calcareous sandstone from approximately 6.0 m depth onwards for thickness of strata ranging from 1m to 5m. This zone may be detrimental to the structures because sandstone is a sedimentary rock, which usually contains caverns occurring at or near the water table. The roofs of caverns may collapse when loaded. Since pile's tip is to rest in the weathered rock, it is suggested that the pile load test should be carried out to determine the safe pile load carrying capacity. The report also recommends for pile load test, which is in right direction.

Dr. F. S. Umrigar
B.E. M.Tech. Ph.D. FIE
Principal



BIRLA VISHVAKARMA MAHAVIDYALAYA
(ENGINEERING COLLEGE)

P O BOX NO 20 • VALLABH VIDYANAGAR-388 120 • GUJARAT • INDIA
PHONE (02692) 230104, 230762 Fax . 236672
EMAIL bvm.princi@yahoo.com
Website http://bvmengineering.ac.in

:2:

After going through the complete report, the following recommendations are made:

- 1) The top sandy layers are too weak for shallow foundations and some ground improvement techniques should be applied or pile foundation should be used. However, for very small loadings, the foundations can be constructed on such soils.
- 2) The pile's tip should preferably cross the highly weathered calcareous sand stone.
- 3) The pile load test should be carried out to evaluate the safe load carrying capacity of a pile as mentioned in the soil investigation report.

Vetted by (Dr. A.K. Verma)

Head

Structural Engg. Dept.

PRINCIPAL



**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

DOMESTIC COMPETITIVE BIDDING

Tender No: COCONTS/ 0010 K/RT/NTPL/Addl. Chimney /2020, Dt. 01.07.2020.

Date & Time of Opening: 04.08.2020 at 15.00 Hrs. (IST)

TENDER SPECIFICATION

for

**Construction of One RCC Additional Chimney of 150 M height with
Borosilicate lined Bi-flue can arrangement for Flue Gas Desulphurization
Plant of 2X500 MW Coal based Thermal Power Plant located at Tuticorin,
Tamil Nadu, India.**

VOLUME – II B SEC - II

STACK ELEVATOR



Development Consultants Pvt. Ltd.

July 2020



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION-II
STACK ELEVATOR**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-II
Stack Elevator**



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

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SECTION-II

STACK ELEVATOR

1.00.00 INTENT OF SPECIFICATION

This Specification covers design, constructional features, material requirement, manufacture, erection, performance requirement, testing etc. of One (1) no. Rack & Pinion type Vertical Stack elevator complete with all driving equipment, auxiliaries and accessories for 150 meter long twin flue wet chimney (Stack) with borosilicate lining.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture, inspection and testing of Elevator shall comply with all currently applicable statutes, regulations and safety codes. Other internationally acceptable standard/codes, which ensure equal or higher performance than those specified shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Owner/ consultant shall be final and binding. The design unless specifically stated otherwise, confirm to following specific codes and standards as applicable, including its latest amendments subsequent to the date of publication as mentioned below:

- 2.01.01 IS: 14665 (Part-1) : Electric Traction Lifts, Guidelines for outline dimensioning.
- 2.01.02 IS: 14665 (Part-2) : Electric Traction Lifts, Code of practice for installation, operation & maintenance.
- 2.01.03 IS: 14665 (Part-3) : Electric Traction Lifts, Safety rules.
- 2.01.04 IS: 14665 (Part-4) : Electric Traction Lifts, Components.
- 2.01.05 IS: 14665 (Part-5) : Electric Traction Lifts, Inspection Manual.
- 2.01.06 IS: 7759 : Specification for Elevator door locking devices and contacts
- 2.01.07 IS-2365 : Specification for Steel Wire Suspension Ropes for Lifts and hoists.
- 2.01.08 State's Elevator and Escalator Act.
- 2.01.09 State's Elevator and Escalator Rules
- 2.01.10 Indian Electricity act.
- 2.01.11 Indian Electricity Rules.

2.02.00 Wherever specified or required the Plant shall conform to various statutory regulations. Wherever required, approval for the equipment supplied under the specification from statutory authorities shall be the responsibility of the bidder.





3.00.00 SCOPE OF WORK

3.01.00 One (1) no. Rack & Pinion type Vertical Stack elevator complete with all driving equipment, auxiliaries and accessories for 150 meter long twin flue chimney /Stack shall be supplied by the bidder.

The scope of work shall include design, engineering, fabrication, installation, commissioning and testing of rack and pinion type elevator including required enclosures, elevator, mast and guide rail, cab drive unit machinery, power cables, control cable, mechanical and electrical equipment for bi flue chimney. The elevator including electrical and mechanical components shall be installed inside the chimney. The design of the elevator shall be in such a way that the elevator operation shall be safe even with expected maximum deflection of the chimney structures. Contractor shall submit the elevator GA and cross section drawing along with the bid for review.

The stack elevator and accessories to be furnished and put into operation and all other required services are detailed herein under. The items, though not specifically mentioned herein but needed to make the system complete in all respects and reliable for safe and smooth operation and guaranteed performance shall also be treated as though included and the same shall be furnished, unless otherwise specifically excluded elsewhere. The items, though not specifically mentioned below but mentioned elsewhere in the specification shall be included in the scope of work.

The required equipment and services shall be as described below:

- i) One (1) no. 400 kg (minimum) capacity rack & pinion type stack elevator complete with all other accessories and associated steel works.
- ii) Electrical equipment such as motors, starters, switches, switch gears, control panels, interlocks, control & power cabling and earthing of electrical equipment.

3.02.00 Accessories

Each elevator shall consist of following:

- a. Elevator car complete with door, door hangers and tracks, push button station, operating panel, car position indicators, illumination fittings, fan fittings and other required accessories. Lighting point and plug point shall be provided over the elevator car roof for the purpose of maintenance work.
- b. Mast, guide rails, Cab, Cab Frame, Cab doors, guide rollers and structural steels, terminal buffers and guide rail lubrication device.
- c. Complete drive machinery and accessories e.g. electric motor, gear box etc., electrical and control equipment including cables & isolating switch including Power & lighting distribution boards etc.
- d. Necessary brakes and limit switches, safety locks for car and landing door & all other protective devices including switch, fuse, starters etc.





All rigid/flexible conduit, ferrules, lugs, glands, terminal blocks, cable clamps, general purpose flexible/Trailing cables automatic leveling device and other miscellaneous items as required.

- e. Hoist-way doors and push button station with digital lights at each landing.
- f. Provision of Battery back-up for emergency lighting inside the Elevator car and alarm, in case of power failure.
- g. Facility of intercom in the Elevator car with necessary wiring for connection from car to a terminal box adjacent to bottom most landing and to the Plant Control room as well as Maintenance Engineer room.
- h. Any other fittings and accessories required for safe and efficient operation of the equipment.
- i. Firemen's switch as per rules of fire lifts.

4.00.00 DESIGN & CONSTRUCTION

4.01.00 General

4.01.01 This section covers the design, engineering, fabrication, installation, commissioning and testing of the rack and pinion type vertical lift elevator including required enclosures, elevator, mast and guide rail, cab drive unit machinery, buffers, power cable, control cable, mechanical and electrical equipment. The design of the elevator shall be in such a way that the elevator operation shall be safe at all times.

4.01.02 Elevator shall be capable of operating from the ground floor to the top landing with intermediate stops at all landings as stipulated.

4.01.03 All mechanical and electrical operating devices and trailing cable shall be designed for outdoor operation with dusty and high humidity conditions and shall operate equally well in any ambient temperature as per project synopsis. Additionally, all mechanical and electrical components of the elevator shall be designed to withstand without damage a temperature of 100 degrees C when the elevator is not operating.

4.02.00 Enclosures

A three-sided ground enclosure with one access door shall be provided for ground landing. At each platform landing above ground level, a one sided enclosure with access door shall be provided. Enclosures shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high and epoxy primer coated with two coat of the manufacturer's standard primer and finish paint.

The ground landing shall be provided at a suitable height above the foundation slab to ensure safety and space underneath the cage for buffer and stop. Foundation should be at least 100 mm above local grade. The





space underneath the landing shall be surrounded by foundation enclosure. A staircase shall be provided for access to the cage. Enclosure access doors shall be electrically and mechanically interlocked so that they remain closed and locked except when the cabin is at a landing. Doors shall be bi-parting and swinging type.

Base of the three-sided enclosure shall be securely anchored to the ground level floor slab using expansion type anchors.

4.03.00 Mast

Mast shall be provided in sections of approximately 1.52 m length welded together to form a frame work to which the rack is bolted. Mast shall be securely anchored to the structure at suitable distances.

4.04.00 Cab

4.04.01 Cab frame shall be fabricated from tubular steel and enclosed with expanded metal or wire mesh.

4.04.02 Cab floor shall be skid resistance glass fiber reinforced plywood or approved equal. Cab shall be attached to a framed structure and form an integral part with the drive mechanism located at the top of the cab.

4.04.03 Framed structure shall include guide rollers and safety hooks to ensure positive engagement of the rack and pinion to prevent cab disengagement in case of roller failure.

4.04.04 Cab roof shall be provided with an escape hatch electrically interlocked with elevator control system. Tubular steel handrail shall be provided on the cab roof for maintenance purposes.

4.04.05 Cab door and landing level enclosure doors shall be electrically and mechanically interlocked to prevent the cab from being operated unless the cab door and landing level enclosure doors are fully closed and to prevent the doors from being opened while the cab is in motion. Cab door shall be of Closed Collapsible Sliding Gate type with manual operation.

4.04.06 One no. cabin fan, two no. recessed fluorescent lamp fittings and one no receptacle with duplex outlet (5A,240V each) to be provided alongwith one no. emergency light with battery charger. Cab interiors shall be paneled with stainless steel sheets.

4.05.00 Drive Unit & Safety Device

4.05.01 Drive unit located on top of the cab shall be complete with AC squirrel cage induction motor, reduction gear, drive pinion and an over speed governor.

Drive unit shall incorporate an Electro Hydraulic Thruster (EHT) type brake and an external manual brake release. The mechanical compression spring shall be held off by hydraulic pressure. This hydraulic pressure shall be





provided by EHT brakes. In the event of power failure, the brake shall be automatically applied & will stop the cab. The brake shall be of self adjusting type and released by means of a special handle provided in the cab.

- 4.05.02 An overspeed governor in constant mesh with the rack by means of a pinion shall be incorporated to protect the cab against overspeed during the cab downward motion.

At a predetermined speed higher than normal, the centrifugal action of the governor pawl shall actuate the incorporated brake mechanism and stop the downward motion of the cab smoothly. The brake shall remain locked on following this action and has to be manually reset before normal elevator operation can be resumed.

- 4.05.03 A remote control shall be provided testing the safety device of the with remote control facility.

- 4.05.04 The drive system shall be designed so that it will be capable to operate smoothly without any tendency to rock or judder with all vertical, horizontal forces as well as the moments through the rack.

- 4.05.05 A safety device shall be provided in conjunction with the drive unit & shall have a separate flame hardened steel pinion engaging in the rack. The device shall be actuated by centrifugal weight & stops the elevator smoothly in case the normal traveling speed exceeds. The safety device shall remain locked on following this action & has to be manually reset before normal elevator operation can be resumed. For testing the safety device, the elevator shall be provided with a remote control facility. Bidder shall ensure that no person is in cab during the test.

- 4.05.06 The elevator shall be provided with a centrifugal brake to prevent accidental tripping of the safety device if, in case of power failure, the cage has to be taken to the ground by gravity. The motor brake shall be released mechanically by a lever in the cage to allow the cage to move down. The centrifugal brake shall keep the preset speed lower than the tripping speed.

- 4.06.00 Buffers

Sufficient number buffers of spring loaded /hydraulic type shall be fitted below the cab. The buffers shall be capable of stopping the cab without permanent damage or deformation to themselves or any other part of the equipment.

The number of buffers shall be fixed as to ensure proper sharing of impact loads by all of them.

- 4.07.00 Power and Control

All electrical components furnished with the elevator shall be completely wired, energized and checked. Necessary power distribution arrangement shall be provided by the Contractor to feed electrical power to elevator.

All electrical control devices shall be in enclosures. Equipment furnished shall





include the following:

- a) Momentary contact push button for raise/lower control.
- b) Reversing combination motor starter with a moulded case circuit breaker for the motor. Starter shall be equipped with three thermal overload relays for motor protection. Operating handle for the combination starter circuit breaker shall be accessible from inside the cab and shall also serve as an emergency stop switch.
- c) Deleted.
- d) Over travel protection, emergency stop push button, over speed governors.
- e) All electrical and mechanical interlocks on cab access door and landing level enclosure doors, phase reversal protection shall be provided.
- f) An alarm push button shall be provided in the cage connected to a battery operated alarm at the elevator base. Simultaneous alarm shall also sound at the unit control room (UCR) in the event of any fault in the stack elevator for which one potential free contact shall be provided in each elevator for audio visual alarm in PCR for "Stack Elevator Fault" indication.
- g) Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase in the power supply.
- h) Continuous duty electric torque motor recoil cable reels as required to maintain electrical power service to all elevator electrical components throughout the limits of travel.
- i) One auxiliary panel shall be furnished and mounted on the grade level enclosure. Panel shall be equipped with a main "ON-OFF" isolating switch, main contactor, relays, control transformer and fuses, tone frequency transmitter, terminal blocks and all other accessories required for normal operation of the elevator.
- j) One main control panel shall be furnished and mounted on the top of the cab. Panel shall be equipped with necessary equipment like rectifier, battery, charger, tone frequency receiver, contactors, MCBs, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator.
- k) Control cabinets shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be cold rolled and at least 2.0 mm thick and properly braced to prevent wobbling. Degree of protection of the control cabinets shall be IP-52 as per IS:2147. Control cabinets shall be provided with hinged door(s) with padlocking arrangement. All doors, removable covers and plates shall



be gasketed all around with neoprene gaskets, louvers, when provided, shall have screens and filters. The screens shall be of fine wire mesh made of brass. Suitable cable gland plate shall be supplied fitted on to this gland plate. All cable glands shall be screwed on type and made of brass.

- l) Each motor to be controlled from the control cabinet shall be provided with 3 pole isolating switch. HRC fuses, contactors of AC4 duty class with thermal overload relays with single phasing preventer and other equipment required for satisfactory control motor. The isolating switch and contactor shall be rated atleast 20% more than the connected motor full load current. Motors of 0.37 KW and above shall be rated for 415 V, 3 Phase and below 0.37 KW will be 240 V single phase supply.

The controllers and resistors for motors shall conform to IS-8544 (latest edition) and IS-2959 (latest edition) and shall be continuously rated for 150% full load current of the motor. Switches shall be hand operated, air breaker heavy duty, quick make, quick break type conforming to IS-4064. The rating of switch shall be so chosen as to get complete protection by associated O/L relay or fuse under all normal/abnormal conditions such as full load, overload, locked rotor, short circuit etc. The incoming power supply isolating switch shall be inter-locked with the control cabinet door so as to prevent opening of the door when the switch is closed. Device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

- m) All fuses shall be of the HRC cartridge type mounted on plug in type of fuse base having a prospective current rating of not less than 80 KA. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded and it shall be possible to change fuses with the circuit alive without danger of contact with live metal.
- n) Contractor shall provide dry type transformers with class B insulation for control power supply, lighting and space heating. Control supply will be 240 V AC. Transformer for control supply shall be provided with a control tap at 110 V which will be earthed. Power and control supply to individual drives and users shall be distributed with separate isolating switches and primary and secondary fuses.
- o) All push buttons shall be of push to actuate type having 2 "NO" and 2 "NC" self-reset contacts. They shall be provided with integral escutcheon plate engraved with their functions. Push button contacts shall be rated for 5 Amp at 415 V AC and 1 Amp. inductive breaking at 250 V DC. Mushroom type emergency push button to open the main contactor shall be provided in the operator's cabin and two on the bridge platform within easy reach. Indicating lamps shall be of the filament type and low watt consumption lamps shall be provided with series resistors.



- p) Strip type space heaters of adequate capacity shall be provided inside in each cabinet.
- q) Control cabinets shall be supplied completely wired. All wiring shall be carried out with 650 V grade PVC insulated, stranded conductors. Power circuits shall be wired with stranded aluminium conductors of adequate sizes to suit the rated circuit current, the minimum size shall be 6 sq.mm Control circuits shall be wired with stranded copper conductors of sizes not small than 2.5 sq.mm. Control circuits shall be isolated from power circuits.
- r) Cab shall be controlled by a semi-automatic floor selection control system. Cab shall be furnished with 240 Volt grounding type receptacle, emergency alarm push button with a normally open contact rated 0.5 Amp. at 220 V DC, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the cab main control panel to the auxiliary panel at ground level. Cable shall supply the cab with all power requirements. Cable guides shall be installed at every 6 metres to avoid entanglement of this cable. Control signals between the auxiliary panel at ground level and the main control panel on the cab, will be provided with the tone frequency receiver. However control and interlocks from the landings shall be connected to the auxiliary panels located at ground level through fixed cables. The power and control cables and trailing power cables shall be FRLS type.
- s) Each landing assembly shall include a limit switch for door interlock and push-button control station installed and wired to a landing junction box.
- t) Cable trolley with cable guides for recoil of cable on to cable reel to maintain electrical power service to all elevator component through out the limits of travel.
- u) Contractor shall furnish, install, and connect a system equipment ground to the Owner's existing chimney ground system. System equipment ground shall electrically connect panels and junction boxes which contain electrical devices, motors, and elevator platforms and support structure. Raceway system shall not be considered as an equipment ground.
- v) All enclosures containing electrical devices shall be provided with 240 Volt, single-phase space heaters with adjustable thermostat control.
- w) All power cables and raceway shall be furnished and installed by the Contractor for interconnection of the main control panel, auxiliary panel and landing junction boxes etc. Conductors included in the cable shall be as required to energise all electrical equipment furnished with the elevator. Transmission of alarm signals is done by means of tone frequency equipment. Hence communication conductors are not required.



4.08.00 Electric Motor

Elevator drive motor shall be squirrel-cage induction type designed and fabricated to conform to the requirements indicated on the drawings.

Motor shall be designed for operation at the required speed; 415 Volts, 3 phase, 50 hertz, and shall be suitable for full voltage starting, S4 duty class as per IS-4722 with CDF of 25% and maximum number of 120 starts per hour in 55 Deg. C ambient temperature. Motor shall be tested at the factory to determine that it is free from electrical or mechanical defects.

Motor nameplate KW rating shall not be exceeded when the equipment is operating within the limits of the maximum load requirements.

Motor shall have sealed Class B non-hygroscopic insulation (IS-325) or equivalent international standard including two additional dips and bakes of epoxy varnish or vacuum impregnation. Insulation system shall be the motor manufacturer's standard premium insulation offering.

Motor shall be totally enclosed and furnished with cast iron frame, brackets, gasketed conduit box and fan cover. Motor shall be furnished with grease pre-lubricated, double-shielded, anti-friction bearings having life rating of not less than 42,500 hours under coupled service retirements. All exposed metal surfaces shall be protected with a polyester paint or coating which is moisture and corrosion resistant.

Motor shall be provided with internal 240 Volt AC single-phase space heaters or an alternate heating system to prevent condensation within the motor during extended periods of idleness. Motor heating system shall be acceptable to Owner.

Motor and driven equipment shall be direct coupled or belted as required, and mounted on a common base plate with coupling or belt guard. Motor shall be completely assembled, lubricated, and ready for operation.

Intent of these specifications is that the motor supplied be designed and constructed for the intended service. Motor construction and duty cycle shall conform with all requirements of applicable safety codes and standards for the service. For additional requirements Volume-II B section-III shall be referred to.

4.09.00 Raceway

a) General

Complete raceway system for the elevator shall be furnished and installed in accordance with this section and the Contractor's shop drawings as reviewed and accepted by the Owner. The Contractor shall provide drawings for acceptance showing the routing of conduit



and wiring for the control circuits associated with the elevator.

Raceway system is defined to include conduit and all related materials and devices required to support, secure and provide a complete system for support and protection of electrical cable and wiring.

Raceway shall be furnished and installed as required to extend raceway which has been installed under separate specifications for entry for circuits to the chimney facilities from external plant area. Raceway shall be provided for all cable and wiring installed under these specifications.

b) Materials

Raceway shall be rigid galvanised steel conduit, provided in accordance with IS-1653 (latest edition).

Steel conduit, couplings and elbows shall be hot-dip galvanised rigid mild steel. Each length of threaded conduit shall be complete with a coupling on one end and a thread protector on the other. Thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage. Flexible conduits shall be plastic jacketed, liquid tight galvanised steel.

Galvanised steel fittings shall be used with galvanised steel conduit. Fittings installed outdoors or in damp locations shall be sealed and gasketed. Outdoor fittings shall be of heavy cast construction.

Bushings shall be provided at the termination of all conduit not terminated in hubs and couplings. Insulated bushings with insulating inserts in metal housings shall be provided on conduit 32 mm diameter and larger. Insulated bushings shall be grounding type standard bushings and shall be galvanised.

One interior and one exterior locknut shall be provided for all conduit terminations not provided with threaded hubs and couplings. Locknuts shall be designed to securely bond the conduit to the box when tightened. Locknuts shall be so constructed that they will not be loosened by vibration.

Raceway supports shall be galvanised steel materials. Hanger rods shall be 13 mm diameter threaded steel rods. Supports for conduits in single runs or groups of two shall be one-hole cast metal straps and clamp-backs unless other types are acceptable to the Owner. Supports for banks of three or more conduits shall be constructed of support channels with associated conduit clips. Support channels for galvanised steel conduit shall be hot-dip galvanised after fabrication.

Junction box enclosure, type, and material shall be as indicated on the drawings or as stated in these specifications. Junction boxes, pull



boxes, and cabinets shall not have knockouts. Junction boxes for indoor service shall be of sheet steel hot-dip galvanised after fabrication and shall be dust resisting enclosure. Except as indicated otherwise in these specifications, all junction boxes for use in outdoor or damp locations shall be galvanised malleable iron or equivalent cast ferrous metal. Junction boxes and outlet boxes installed on the exterior shall be galvanised steel.

Outlet boxes, switch boxes, and associated fittings shall be galvanised iron or equivalent cast ferrous metal.

c) Installation

Contractor shall field route conduit according to the general routing indicated on the drawings reviewed and accepted by the Owner and shall coordinate conduit locations with other equipment and structures. Wherever practical, conduit shall be routed so that, except where it is changing elevation or being lowered to enter equipment, the lowest part of the conduit, including its associated supports and appurtenances, is at least 2.1metres above the closest walking surface beneath it. Conduit, including its associated supports and appurtenances, routed above work areas, walkways and platforms, shall be at least 2.1metres above the closest walking surface beneath it. It may be routed a reasonable distance away from the supporting wall of ceiling, so long as the specified support is provided, interference with other equipment and structures is avoided, and the routing is acceptable to the Owner. Conduit including its associated supports and appurtenances, which must be routed closer than 2.1metres above the closest walking surface beneath it shall be routed as close as possible to surface of walls and the equipment served. Except as otherwise specified or indicated on the drawings, all conduit shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Vertical conduit runs between platforms, shall be routed on the inside wall of the concrete chimney. Conduit which is stubbed up shall remain plugged until the conduit is extended. Conduit field routing shall be acceptable to the Owner. Routing if not acceptable, shall be rerouted and replaced without any expense to the Owner.

Moisture pockets shall be eliminated from conduits. If water cannot drain to the natural opening in the conduit system, a hole shall be drilled in the bottom of a pull box or a "C-type" conduit fitting provided in the low point of the conduit run.

Metal conduit shall be joined by threaded conduit couplings with the conduit ends butted. Use of running threads will not be permitted. Where metal conduit cannot be joined by standard threaded couplings, conduit unions or split couplings may be used if both material and location are acceptable to the Owner. Only ground seat type water-tight unions shall be used where the union may be submerged.

Run of conduit shall not contain more than the equivalent of four quarter bends, including those immediately at outlets or fittings. Bends in conduit



shall be made without reducing the internal diameter of the conduit. Use of a pipe tee or vise for bending conduit will not be permitted. Inside radius of conduit bends shall be not less than six times the inside diameter of the conduit. Conduits deformed or crushed in any way shall be removed from the job site.

Plane of all conduit ends shall be square with the center line. Where threads are required, they shall be cut and cleaned prior to conduit reaming. Ends of all conduits shall be reamed to remove all rough edges and burrs. Cutting oil shall be used in threading operations, the dies shall be kept sharp, and provisions shall be made for chip clearance. All steel conduit, after threading, shall be regalvanised by an acceptable galvanising process. Contractor shall supply this protective material and shall apply it in the field.

Conduit shall be securely fastened to all boxes and cabinets. Threads on metallic conduit shall project through the wall of the box to allow the bushing to butt against the end of the conduit. Locknuts both inside and outside shall then be tightened sufficiently to bond the conduit securely to the box.

Precautions shall be taken to prevent the accumulation of water, dirt, or concrete in the conduit. Conduit in which water or other foreign materials have been permitted to accumulate shall be thoroughly cleaned or, where such accumulations cannot be removed by methods acceptable to the Owner, the conduit shall be replaced.

Equipment and devices which move in relation to the supply conduit due to vibration, normal operation of the mechanism, or thermal expansion shall be connected to the supply conduit using not more than 760 mm of flexible conduit adjacent to the equipment or device.

Expansion fittings shall be installed between rigidly mounted fittings in vertical raceway. Distance between expansion fittings in any individual raceway shall not exceed 15 metres.

All conduit runs shall be rigidly supported. Each conduit shall be supported within 300 mm of Junction boxes and fittings. Support spacing along conduit runs shall be as follows:

Conduit Size	Maximum Distance Between Supports
Smaller than 40 mm dia. :	1.5 metres
40 mm dia. and larger :	3 metres

Cabinets and boxes shall be rigidly mounted. Mounting on concrete shall be with bolts and expansion anchors. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. Cabinets shall be levelled and fastened to the mounting surface with not less than 7 mm air space between the enclosure and mounting surface. All mounting holes in the enclosure shall be used. Except as prevented by the location of other work, all junction boxes and outlet boxes shall be



centered on structures. Conduit openings in steel boxes shall be made with a hole saw or shall be punched. Cable support boxes shall be installed to be accessible from platforms.

Where supports for raceway, boxes, and cabinets are mounted on concrete surfaces, they shall be fastened with expansion shell anchors with externally split expansion shells, single cone expander and anchor break off grooved checking cones.

Contractor shall be responsible for all openings for passage of electrical raceways. Required openings not provided during chimney construction shall be provided by the Contractor using a hacksaw, a hole saw or a core drill subject to the acceptance by the Engineer-in-Charge. Opening in concrete for single conduits shall be cut by the Contractor with core drills and the conduits shall be grouted in place after being installed.

Field cutting of grating will be allowed only where specifically acceptable to the Engineer-in-Charge. Alternate routing of raceways should be used to avoid conflict with grating. If field cutting is absolutely necessary, the openings shall be made at divisions or ends of grating sections. Openings shall be square and shall be neatly finished. Rough spots shall be ground until smooth and re-galvanised as required. Openings in grating shall be sawed, not burned.

Openings that have been cut through concrete for the passage of raceways shall be finished by grouting around the conduits.

Welding shall completely fuse the welded member to the supporting steel and shall be neat in appearance. Clamps shall be used for making attachments to structural steel for installation purposes wherever possible. Welded lugs will be permitted only when specifically accepted by the Engineer-in-Charge. All temporary supports which have been welded to the structural steel shall be removed as promptly as possible. After removal, the roughened surface of the steel shall be ground smooth and a protective primer paint applied equal to that which was initially applied in the shop.

Unfinished runs of raceways shall not be used. Supports and connections for each raceway run shall be completed prior to the pull-in of any pulling line or conductor.

4.10.00 PVC Insulated FRLS Cable

a) Materials

Vol-II-B section-III of this specification shall be referred for FRLS cable. Unless specified otherwise, Contractor shall submit to the Engineer-in-Charge four copies of the manufacturer's test report on each cable furnished. Conductor accessories including terminal materials like glands, lugs etc. markers, tying materials and cable support shall be furnished and installed. Wire termination materials for conductors 10 sq.mm and larger shall be pressure or bolted type. Terminals for conductors smaller than 10 sq.mm shall be an insulated pressure connection in the shape of a ring.





b) Installation

Power and control cables shall be routed as required by the drawings. Cables pulled into the wrong conduit or cut too short shall be replaced. Cables removed from one conduit shall not be installed in another conduit.

Only lubricants recommended by the cable manufacturer and acceptable to the Owner shall be used.

Outside of each cable reel shall be carefully inspected and protruding nails, fastenings, or other objects which might damage the cable shall be removed. Thorough visual inspection for flaws, breaks, or abrasions in the cable sheath shall be made as the cable leaves the reel and the pulling speed shall be slow enough to permit this inspection. Damage to the sheath or finish of the cable shall be sufficient cause for rejecting the cable. Cable damaged in any way during installation shall be replaced by and at the expense of the Contractor.

Pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both the manual and power types used by the Contractor shall have the rated capacity clearly marked on the mechanism. Whenever the capacity of the pulling mechanism exceeds the recommended pulling tension of the cable as given by the cable manufacturer, a dynamometer shall be used to indicate the tension on the cable and the indicator shall be constantly watched. If any excessive strain develops, the pulling operation shall be stopped at once and the difficulty determined and corrected. Extreme care shall be exercised during the installation of all cable to prevent tension and bending conditions in excess of the manufacturer's recommendations. Permanent radius of bend after cable installation shall be in accordance with the cable manufacturer's recommendations.

Cable supports and securing devices shall have bearing surfaces located parallel to the surfaces of the cable sheath and shall be installed to provide adequate support without deformation of the cable jacket or insulation. Adequate cable end lengths shall be provided and properly installed in junction boxes to avoid longitudinal strains and distorting pressures on the cable at conduit bushings.

Final inspection shall be made after all cables are in place and where supports and bushings deform the cable jacket, additional supports shall be provided as directed by the Owner. Additional cable protection such as a wrapping of light rubber belting, friction tape or similar material may be required. Cables in vertical runs shall be supported as indicated on the drawings.

Not less than 8 mm shall be allowed in each 15 metres vertically supported length of conductor for expansion and contraction.

Contractor shall identify the ends of all power and control circuits. He shall also identify all circuits in pull boxes. Each marker shall bear the number of the corresponding circuit according to the drawings.



Splices shall not be made in conductors.

Terminations shall be in accordance with the following requirements :

- i) Train cable in place and cut squarely to required length. Avoid sharp bends.
- ii) Remove necessary amount of cable jacket and insulation without damage to the conductor.
- iii) Install terminals or connectors as required, ensuring a firm metal-to-metal contact.
- iv) If the connection requires insulation, (i.e. cable connects to insulated conductors), apply three half- lapped layers of insulating tape over the joint, extending to two cable diameters over the cable jacket and a similar distance over any other insulation or connection requiring insulation.

Insulated conductors shall be tested after installation with a 1000 volt megger or an equivalent testing device and shall indicate approximately infinite resistance between conductors of the same circuit and between conductors and ground. Equipment and labour required for testing shall be provided by the Contractor. Any circuit failing to test satisfactorily shall be replaced or repaired and retested as directed by the Owner.

4.11.00 Earthing

a) General

Earthing system furnished and installed shall include a complete earthing system for the elevator. Earthing equipment and materials shall be furnished and installed in accordance with the reference codes and standards, these specifications, and the Contractor's shop drawings as reviewed and accepted by the Owner.

b) Materials

The earthing of all electrical items shall be supplied by the Bidder. For earthing of various equipment, conductor sizes shall be as listed below:

- | | | | |
|------|---|---|-----------------------|
| i) | MCCs Motors above 90 KW
control panels, cable trays, etc. | : | 50 x 6 sq.mm G.I.flat |
| ii) | Motors above 30 KW, upto
90 KW and lighting panel/
control panels/auxiliary
panels | : | 35 x 6 sq.mm G.I.flat |
| iii) | Motors above 5 KW upto 30 KW | : | 25 x 3 mm G.I. flat |



- iv) Motors upto 5 KW and misc.
small item like conduits,
junction boxes etc. : 8 SWG G.I. Wire

The earthing strip/wire shall be connected to the earthing mat by the Bidder provided in the chimney area. Clamps and other hardware of iron or steel used with the grounding system shall be hot-dip galvanised. Bolts, washers and nuts shall be hot-dip galvanised steel.

- c) Installation

Exposed conductors shall be installed inconspicuously in vertical or horizontal positions on supporting structures. When located on irregular supporting surface or equipment, the conductors shall run parallel or normal to dominant surfaces.

Conductors routed over concrete, steel or equipment surfaces shall be kept in close contact with those surfaces by using fasteners located at intervals not to exceed one (1) metre. Damaged earth system conductors or cables shall be repaired or replaced by the Contractor as directed by the Owner.

Earth connections except equipment earthing connections shall be made by electric arc welding. Bolted connections shall be used for earthing equipment.

Earthing bushings within all enclosures, including equipment enclosure, shall be wired together and connected internally to the enclosure earthing lug at earthing bus with bare conductor.

Electrical equipment shall be earthed. Large equipment will be furnished with earthing bus. Most other equipment will be furnished with earthing pads and/or earthing lugs. Earth connection surfaces shall be cleaned immediately prior to connection. Where the earth conductor is included with the power conductors in the motor circuit raceway a compression type earth conductor termination shall be used and connected to the motor frame inside the motor terminal housing. Where the earth conductor is not included with the power conductors in the motor circuit raceway, the motor frame shall be earthed to the earth grid.

Suitable earthing facilities acceptable to the Owner shall be furnished on motors not so equipped. Earthing facilities shall consist of compression type earth conductor termination bolted to the motor frame and providing a minimum of joint resistance. Conduit system is not considered to be earthing conductor. No earthing conductor shall be smaller in size than 4 sq.mm unless it is a part of an acceptable cable assembly.

5.00.00 OPERATION AND CONTROL PHILOSOPHY

- 5.01.00 The elevators, while starting from any level, shall start at rated speed but during stopping, elevator shall slow down to lower speed when the car reaches around one meter of the selected landing floor and stop when reached the landing floor. The control system shall be through





microprocessor based AC variable voltage and variable frequency drive with remote control and wireless technology.

5.02.00 The stack elevator shall be capable of operating from the ground floor to the top interior platform with intermediate stops at all interior platforms. Bottom cage shall be rested on ground and the Bidder shall provide ladder to take entry to the elevator from ground level.

5.03.00 The stack elevator shall be attendant operated and shall not be under automatic mode of operation.

5.04.00 The operation of the elevators shall be through soft touch keys located inside the lift car. Suitable interlock shall be provided so that the elevators shall not move unless the door is properly closed. The landing doors of any floor shall not open when the elevator is not on that floor. Soft touch keys shall be fixed in one car for holding the doors open for any length of time required.

5.05.00 The elevators under this section shall be treated as "Fire Lifts". "Fire Switch" in a glass front box shall be provided adjacent to the lifts at the entrance level, the function of which is to enable the fire authority to take over the complete control of the lifts, when required. When the switch is on, landing call points shall become inoperative and the lift shall be on the car control only. When the switch is off, the lift will return to normal working.

6.00.00 TESTING AND INSPECTION AT MANUFACTURER'S WORKS AND SITE

6.01.00 The details of the checks to be carried out in the various equipments are to be submitted by the contractor for owner's approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance plan to be agreed with the owner.

6.01.00 All forgings shall be subjected to ultrasonic test to ensure free from internal defects in addition to check for chemical and mechanical properties.

6.02.00 10% of the welds selected at random shall be subject to DP test.

6.03.00 All forged components shall be subjected to DPI/MPI after machining.

6.04.00 Gear Reducer shall be checked for gear ratio, backlash, and contact pattern. No load shop trial run shall be conducted on gear boxes to check for oil leakage, temperature rise, noise and vibration.

6.05.00 Buffer springs shall be subjected to load test as per relevant specifications. Material certificates for springs shall also be furnished.

6.06.00 All components prior to assembly shall be checked for dimensions.

6.07.00 Function test of Elevator assembly shall be carried out.

6.08.00 All electrical equipments shall be of proven quality.



6.09.00 Galvanized components/parts shall be checked for weight of Zn coating, thickness of coating, uniformity of coating and adhesion test and visual examination as per IS 2633 and IS 2629.

6.10.00 Motor shall be subject to both types and routine tests in accordance with IS-325. In addition, the following tests shall also be carried out :

- a) 20% over speed test for 2 minutes
- b) Vibration measurement
- c) Measurement of noise level as type test
- d) Degree of protection test on both motor enclosure and terminal box as per IS-4691 as type test.

6.11.00 Following items shall be tested as per relevant standard :

- a) Trailing cable
- b) Brake coil
- c) Relay contactors, instruments and controlling equipment.

6.12.00 The control panels shall conform to specific degree of protection and a type test certificate shall be submitted for Owner's approval. In absence of the same to Owner's satisfaction, the bidder shall get first panel of each type tested for specified degree of protection as per IS-2147.

Site Tests

6.13.00 After installation of complete elevator, necessary trial run and tests (No Load, ON Load, Full Load & Over load) shall be carried out by the bidder in the presence of owner to determine that the equipment supplied is satisfactorily installed and commissioned.

6.14.00 It shall also be the responsibility of the bidder to demonstrate the operation of the safety interlocks provided to the full satisfaction of the elevator inspector.

7.00.00 DRAWINGS, DATA, AND INFORMATION

7.01.00 In addition to the Proposal Data Sheets in Volume-III of this specification duly filled up, Bidder shall submit the following drawings/data/information for the elevator along with this offer.

7.02.00 Layout drawing showing principal dimensions of the elevator car in plan and the elevator car and shaft in elevation.

7.03.00 Layout drawing showing the location of various equipment in the elevator machine room.

7.04.00 Complete general arrangement drawing of the elevators and its support structure showing all landing levels and enclosures.

7.05.00 Electrical Control Schematics.



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- 7.06.00 Write-up, description and illustrative pamphlets on various components of the elevator and its control, interlock and safety devices.
- 7.07.00 Detailed drawing of mast including fixing details of mast sections on the chimney wall for stack elevator.
- 7.08.00 Foundation details and loading.
- 7.09.00 Load on elevator columns.
- 7.10.00 Layout of conduits, conductors, cables etc.
- 7.11.00 Other drawings, data sheets and literature as necessary.
- 7.12.00 Instruction manual for erection, testing and commissioning.





ANNEXURE-I

DATA SPECIFICATION SHEET

1. Location of Elevator : Stack / Chimney
2. Type of Service : Passengers-cum-Goods
3. No. of Elevators (no.) : One (1)
4. Type of Elevator : Rack and Pinion Type, Vertical Elevator
5. Carrying Capacity : 400 Kg (Minimum)
6. Total Height of Chimney : 150 M
7. Drive Motors (AC) : One (1) No.
8. Total travel : 150 M
9. Entrance : 1 No.
10. Method of Control : Semi-Automatic
11. Cab floor : Skid Resistance Chequered Pate/GRP plywood
12. Cab Floor Size : 1100 mm x1000 mm (minimum)
13. No of landings : * Minimum 5 Nos. [EL 1.2M, 40.0 M, 80.0 M, 120.0 M,135.0 M (to be finalized by the bidder during the course of detail engineering)] bidder to provide landing for all internal/external platform levels.
14. Operating Speed : 40 m / min (approx.)
15. Power Supply : 415V, 3 Phase, 50Hz, 4 wire(solidly grounded),dual power source arrangement shall be provided.
16. Roller Guides for Cage Frame: At least six (6)
17. Other Requirements :
 1. Plant telephone communication system shall be extended up to the elevator car.
 2. Suitable arrangement shall be provided to intimate unit control room during emergency in the form of audiovisual alarm.
 3. Automatic rescue device.



Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

18. Car Enclosure : SS construction.

Note:- 1. Top of RCC roof slab is around EL 145 M. Accordingly Bidder to check and confirm the available headroom clearance.
2. Special tools and tackles as required for the maintenance of the elevator shall be included in Contractor's scope of supply.

ANNEXURE-II
Mandatory Spares

Sl. No.		
1.	Bearing for Guide Roller	1Set
2.	Bearing for Counter Roller	1Set
3.	Drive Pinion	1No.
4.	Brake (EHT)	1 No.
5.	Brake Centrifugal	1 No.





**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

DOMESTIC COMPETITIVE BIDDING

Tender No: COCONTS/ 0010 K/RT/NTPL/Addl. Chimney /2020, Dt. 01.07.2020.

Date & Time of Opening: 04.08.2020 at 15.00 Hrs. (IST)

TENDER SPECIFICATION

for

**Construction of One RCC Additional Chimney of 150 M height with
Borosilicate lined Bi-flue can arrangement for Flue Gas Desulphurization
Plant of 2X500 MW Coal based Thermal Power Plant located at Tuticorin,
Tamil Nadu, India.**

VOLUME – II B SEC - III

ELECTRICAL



Development Consultants Pvt. Ltd.

July 2020



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

VOLUME: II-B

SECTION-III

**TECHNICAL SPECIFICATION
FOR
CHIMNEY-ELECTRICAL WORKS**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
Chimney- Electrical Works**



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SECTION-III

SUB-SECTION-I

GENERAL ELECTRICAL SPECIFICATION

1.00.00 GENERAL REQUIREMENT

1.01.00 General

1.01.01 Bidder shall provide fully compatible electrical system, equipment, accessories and services for the entire Chimney in his scope as well as those specifically required by the Owner.

1.01.02 All equipment, material and systems shall conform to the latest edition of relevant National and International Codes & Standards, in particular the Indian Statutory Regulations.

1.01.03 Drawings and annexure appended to this specification shall form part of this specification and supplement the requirements specified herein. This specification shall be read and construed in conjunction with the drawings and annexure to determine the scope of work and terminal points.

1.01.04 It is not the intent to specify completely herein all details of the system or equipment. Nevertheless, the system/equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.

1.01.05 Any system, material or accessory which may not have been specifically mentioned but which are necessary or usual for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished without any commercial implication to the Owner.

1.01.06 Proposal Data Sheets

The Proposal Data Sheets annexed to this specification shall be filled in without any ambiguity by typing in appropriate place on each page. These pages must be properly signed by authorized representative of the Bidder as verification of the data and submitted along with the bid to form part of the Bidder's formal proposal.

1.01.07 Performance Guarantee

The performance figures quoted in Technical Particular Sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection at any stage.

1.01.08 Deviation





Should the Bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation. All such deviations shall be clearly

mentioned on the Deviation sheet, with reference to the respective clause of the specification. Unless such deviations are recorded in the Deviation sheets and submitted with the offer, it shall be taken for granted that the offer is made in conformity with this specification in all respects.

1.01.09 **Drawing Approval**

Before starting manufacture of any equipment, the Bidder shall have to take approval of relevant drawings and data from Engineer in writing. Any manufacture done prior to the approval of drawings/data shall be rectified in accordance with the approved drawings/data by the Bidder at his own cost and the equipment shall be supplied within the stipulated period.

1.01.10 **Site Condition**

Refer Vol IIA of Lead specification.

1.01.11 **Co-Ordination with Statutory Bodies and Outside Agencies**

The Bidder shall be fully responsible for carrying out all co- ordination and liaison works with Electrical Inspectors, Factory Inspector, and other statutory bodies for implementation of the work.

Applications on behalf of the Owner, for submission to the Electrical Inspector and other statutory bodies along with necessary drawings complete in all respects shall be prepared by the Bidder. Approved drawings and certificates shall be submitted to the Owner/Consultant well ahead of schedule so that the actual commissioning of equipment does not get delayed for want of inspection and approval by the Inspector and other statutory bodies. The actual inspection work by the Electrical Inspector shall be arranged by the Bidder and necessary coordination and liaison work in this regard shall be the responsibility of the Bidder.

1.02.00 **Codes & Standards**

1.02.01 **Equipment**

All electrical equipment and materials shall conform to latest applicable standard publications of International Electro technical Commission (IEC) or equivalent standards published by the Bureau of Indian Standards (BIS) and other standards mentioned in the various volumes of sections of this specification. In case of a conflict between IEC and other standards, the requirement of IEC shall govern. The provisions of tender specifications (except the clause of codes and standards of individual specification) shall however have precedence over all other standards.





1.02.02 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such cases, copies of the English version of the standard adopted shall be submitted along with the bid.

1.02.03 **Installation**

All electrical installation work shall comply with the provisions of the Indian Electricity Act, the Indian Electricity Rules as amended up to date, relevant IS Codes of Practice and recommendations of the Tariff Advisory Committee (TAC). In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rules shall be binding.

Nothing in this specification shall be construed to relieve the Bidder of his responsibility to abide by the Standards or Codes.

1.03.00 **Auxiliary Voltages**

1.03.01 Auxiliary AC voltage supply arrangement shall have 415V system. It shall be designed to limit voltage variations as given below under worst operating condition:

- LT AC System - $\pm 10\%$

1.03.02 Following auxiliary voltages will be envisaged for LT auxiliary power, control and instrumentation.

- 240 V $\pm 10\%$, 1 Ph, 50 Hz +3% to -5%

1.04.00 **Scheme For Auxiliary Power Distribution**

1.04.01 Power distribution diagram of Chimney as shown in the attached **Dwg. No.18A09-CHM-DWG-E-0002** is for Bidder's compliance. To supply power to elevator, different receptacles, lighting panels etc. a 415V main power distribution board (MPDB) and one (1) no. Emergency Power Distribution Board (EPDB) shall be provided by the Bidder.

Two (2) numbers incoming feeders, adequately rated, to this MPDB will be taken by Chimney Package vendor from FGD PMCC, rated 415V $\pm 10\%$, 3 phase, 4 wire, 50 Hz $\pm 5\%$ (fault level 50 KA for 1 sec).

1.04.02 One (1) no. 415V Emergency power distribution board (EPDB) shall be provided by the Bidder. One (1) number emergency power supply feeder to the EPDB shall be arranged by Chimney Package vendor from FGD Emergency switchboard, rated 415 V $\pm 10\%$, 3 phase, 4 wires, 50 Hz $\pm 5\%$ (fault level 50 KA for 1 sec)

1.04.03 Supply, laying, termination and connection of the cabling system and overhead racks /cable trestle etc. between FGD plant switchboard to Chimney switchboard (i.e MPDB & EPDB) shall be included under bidder scope with necessary interfacing with FGD package bidder.





1.04.04 Any other, supply voltage, if required for electrical system of Chimney shall be arranged by the Bidder through suitable means as necessary. Portable type UPS shall be used for supplying UPS power to different type of Analyzer equipment / panel, data logger etc.

1.05.00 **Motor Voltage**

The voltage level for motors shall be as follows:

- a) 415 Volt, 3 Phase, 50 Hz : $0.2 \text{ kW} < \text{Motor kW} \leq 160 \text{ kW}$
- b) 240 Volt, 1 Phase, 50 Hz : $\text{Motor kW} \leq 0.2 \text{ kW}$

1.06.00 **Enclosure Protection**

Degree of protection of enclosures as per IS: 13947 shall be as follows:

Sl. No.	Item	Degree of Protection
1	415V MCC / DBs / Fuse Board	IP52 for indoor and IP65 for outdoor
2	Motor (Indoor/Outdoor)	IP55
3	Motor Actuator	IP65
4a	Pushbutton Station/Kiosk/Panel - Indoor	IP55
4b	Pushbutton Station/Kiosk/Panel - Outdoor	IP65
5	Indoor Junction boxes for cables / wires	IP55
6	Outdoor lighting fixtures	IPW65

1.07.00 **Painting For Electrical Equipment**

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 80 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 80 microns shall be acceptable for finish coat.

1.08.00 **Quality Assurance**

1.08.01 The Bidder shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserve the right to review the same and give his observations, if any, for compliance.

1.08.02 The Owner / Purchaser shall inform the Bidder as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of





the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The Bidder shall give at least fifteen (15) days advance notice regarding readiness of the equipment.

1.08.03 The Owner / Purchaser may conduct surveillance of the Bidder's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

1.09.00 **Drawings / documents for Approval**

1.09.01 The Bidder shall submit his Master Deliverable Schedule considering the priority of the listed documents with respect to the project execution schedule. The document in the schedule should be marked in two categories viz. (a) 'For Approval' (A) and (b) 'For Reference' (R).

1.09.02 The Bidder shall submit document in sequential format i.e. the basic engineering documents in 'For Approval' category and obtain approval of those documents prior to submittal of corresponding detail engineering documents. For the Bidder's guidance - such documents shall include, but not limited to the following:

I.> Approval Category

- a) Master Deliverable List – Electrical with schedule of submission
- b) Design basis report for various equipment/system like :-
 - Design Memorandum - Grounding system
 - Design Memorandum – Lightning protection system
 - Design Memorandum – Illumination system
- c) Power distribution diagram indicating rating of equipment
- d) Sizing Calculation of various electrical equipment/system like –
 - Cables
 - lightning protection
- e) Layout drawings like :
 - Electrical equipment layout of electrical room
 - Cable tray & trestle layout
 - Illumination layout
 - Earthing layout
 - Lightning protection
- g) All drawings/data relevant to the equipment like QAP, Guaranteed Technical Particulars, General Arrangement Drawing etc.

II.> Information Category

- a) Dimensional General arrangement drawing along with cross-sections for equipment
- b) Bill of material
- c) Wiring diagram
- d) Cable schedule & interconnection chart
- e) Cable numbering scheme
- f) Any other drawings & data as required etc.

1.09.03 The Owner's Consultants may review a document assigned in 'For Reference' category as they deem necessary and furnish comments for compliance by the Bidder.





2.00.00 SCOPE OF SUPPLY & WORK

2.01.01 The scope of work related to electrical system is an intrinsic part of the total EPC Contract. The Bidder's scope shall include but not limited to the complete detail design and engineering of electrical works related to power distribution, illumination including aviation obstruction lighting, cabling, grounding, lightning protection, construction, installation, testing and putting into successful commercial operation of the Chimney electrical system.

2.01.02 Scope of work shall also cover the design, manufacture, assembly, testing at manufacturer's works/laboratory, supply, delivery including insurance, properly packed for transport to site, storing at site of all equipment, material and accessories related to above electrical work as detailed hereinafter in this specification.

2.01.03 The work is subject to all the terms and conditions detailed in the documents listed below, which shall form part of this specification as if bound together.

- a) Tender Notice
- b) Instruction to Bidders
- c) General conditions of contract for supply, delivery & installation of plant and materials.

2.01.04 In the event of any discrepancy with listed documents, the stipulation of this specification shall govern.

2.02.00 Scope of Supply

2.02.01 The work involves timely procurement and transportation to site in properly packed condition of all equipment, materials and miscellaneous items required to complete the project.

2.02.02 The scope of supply and services shall include but not be limited to the following for Chimney:

- a) All equipment and materials as indicated under clause no. 2.02.03 & as required.
- b) Mandatory spare parts.
- c) Recommended spare parts for three (3) years operation

2.02.03 Chimney shall be provided with but not limited to the following:

- a) Normal and Emergency Power distribution board and control system
- b) Electrical system for Elevator
- c) Aviation Obstruction Lighting system





- d) Illumination system including complete Aviation lighting (temporary & permanent) and street/area lighting.
- e) Power & Control cables
- f) Cabling, grounding and lightning protection system
- g) All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary.
- h) DC facilities are not envisaged. However, if any DC power requirement is needed by the Bidder the same has to be included in the bidder's scope.

2.03.00 **Scope of Services**

The scope of services shall include detail design for construction and installation of entire electrical system of Chimney Package.

- All cable trays, cable supports, galvanized steel conduits etc. from top to the bottom of Chimney and to MPDB, from FGD emergency board (to be located at FGD Plant electrical room) to EPDB at Chimney and routing of all cables.
- Grounding and lightning protection system including underground grounding mat, over ground grounding grid, air terminal network and connection with main ground grid.
- Illumination system of Chimney and surrounding areas including point wiring with PVC wires in conduits, aviation obstruction light, receptacles and power socket outlets.

Illumination layouts showing dispositions of fixtures, conduit routing.

- Preparation of installation, commissioning, operation and maintenance manuals.
- Obtaining statutory approvals for Aviation warning system from concerned authority.
- Necessary interfacing with FGD Package Vendor is included under Bidder's scope.

3.00.00 **INTERFACING WITH OWNER/FGD PACKAGE VENDOR**

- 3.00.01 Power supply to MPDB and EPDB for Chimney shall be as described under clause no.-1.04.00. Bidder to ensure and indicate the exact power requirement accordingly.





- 3.00.02 Cable Trays, Trestle etc. as required for complete cabling system with necessary hardwires etc. is included under Bidder's scope.
- 3.00.03 Chimney grounding system (both below & above ground), earthing of electrical equipment and lightning protection system is included under Bidder's scope. Bidder shall connect below ground earthing with FGD package earthing minimum at two different points.
- 3.00.04 MPDB, EPDB, Normal Lighting Panels (NLP), Emergency Lighting Panels (ELP) etc. (as required) for Chimney electrical works will be located at ground floor of Chimney.
- 3.00.05 Necessary interfacing with Other Package Vendor/Owner is included under Bidder's scope.

4.00.00 LAYOUT CRITERIA

For finalizing location of Electrical DB's, following minimum requirement shall be complied:

- 4.01.00 Minimum clearance of 800 mm shall be provided on rear of panel for single front boards where rear door width is less than 800 mm. Generally cable trench below any electrical switchboard shall be of adequate width to allow easy approach to panel bottom from rear of panels.
- 4.02.00 In general clearance of 1000 mm will be maintained on rear of single front panels.
- 4.03.00 Clearance between adjacent panels in a row shall be less than 200 mm or more than 800 mm. This clearance shall also be guided by equipment handling space where applicable and space required for movement of personnel.
- 4.04.00 Clearances in between adjacent panels in a row or from the side wall/door shall be so decided that handling of shipping section of any board is not obstructed.

5.00.00 MOTORS

Refer sub-section-II of Volume-IIB.

6.00.00 POWER DISTRIBUTION BOARDS

Refer sub-section-III of Volume-IIB.

7.00.00 DAY MARKING

The external surface of the chimney shall be painted with horizontal strips of 2.5 M wide alternate bands of aviation red and aviation white paint. Quality paint and materials shall be selected, subject to Consultant's approval, to





provide extra years of service. The paint shall be compatible with surfaces to be painted, including any previous coatings, and suitable for the environmental conditions. Surface preparation and paint application shall be in accordance with manufacturer's recommendation.

8.00.00 ILLUMINATION

Refer sub-section-IV of Volume-IIB.

9.00.00 CABLES AND CONDUITS

9.01.00 Power & Control cable shall be as per sub-section-V of Volume-IIB.

Flexible trailing cable shall have annealed tinned copper conductor, EPR insulated, reinforced with nylon cord, cores laid up, HDCSP inner sheathed, cotton taped and HDCSP overall sheathed conforming to IS:9968/relevant IEC. Trailing cables shall be FRLS type.

9.02.00 Required number of GI pipe conduit of size not less than 32 mm dia shall be provided. Each conduit riser shall run from the lowest embedded pull box to the highest junction box. The lowest pull box shall be located 450mm above grade in the chimney shell. Pull boxes shall be installed at every 10m intervals vertically. The conduit risers shall run adjacent to the stairs such that the pull boxes become easily accessible from the stairs.

9.03.00 Each conduit riser shall have one circumferential conduit at each platform level. The circumferential conduit at each level shall be provided with three (3) more junction boxes equally spaced at the locations of the aviation warning lights. Suitable conduits shall also be provided from the junction box to the respective light point. The GI pull boxes and junction boxes shall be of size at least 150mm x 150mm x 100mm, 3mm thk, preferably embedded in the concrete shell.

9.04.00 The conduits shall be electrically connected to all circumferential reinforcing rods which are in turn connected to the down conductors.

9.05.00 Conduit joints and connections shall be made thoroughly watertight and rust proof by application of white lead for embedded portion or red lead for exposed portion.

9.06.00 Conduits shall be hot dip galvanized conforming to relevant IS/IEC.

9.07.00 Conduit system shall be electrically bonded to the grounding system.

10.00.00 GROUNDING and LIGHTNING PROTECTION

Refer sub-section-VI of Volume-IIB.





11.00.00 TESTS

The bidder shall carry out all tests (type as well as routine test) as per relevant IS (Indian standard) for electrical equipment. The tests shall be carried out in presence of Owner's representative, for which minimum fifteen (15) days notice shall be given by the bidder. The bidder shall obtain owner's approval for the test procedure prior to performance of tests. The test procedure shall specify test set-up, instruments to be used, acceptance norms, recording of various parameters, interval of recording, precautions to be taken etc. In addition, any special test if required shall also be performed.

Type test certificate not more than 5 years old shall be furnished for approval.

12.00.00 GUARANTEE

In the installation if any trouble arises due to the use of defective or faulty material and/or bad workmanship within a period of 12 months from the date of taking over, the Bidder shall guarantee to replace or repair the defective part(s) at site to the entire satisfaction of the Owner's Engineer free of charge.

13.00.00 DRAWINGS, DATA AND MANUALS

- 13.01.00 To be submitted with the Bid
- 13.01.01 Power requirement for Chimney.
- 13.01.02 Typical general arrangement drawing of Chimney showing location of lighting fixtures, lightning protection system, grounding system etc.
- 13.01.03 Typical general arrangement drawing of main power distribution board, Emergency power distribution board etc.
- 13.01.04 Catalogue cuts of various types of lightning fixtures, major components, cables, conduits etc.
- 13.01.05 Type Test Certificate of various equipment.



ANNEXURE - A

MANDATORY SPARE PARTS

Sl. No.	Item	Qty.
1	Medium intensity red flashing light	3 Nos.
2	Low intensity steady light	3 Nos.
3	Control Unit for aviation warning light	2 Nos.
4	Lighting transformer	1 No.
5	M.C.C.B.	One (1) of each type and rating
6	M.C.B.	Five (5) of each type and rating
7	Motor	One (1) of each type and rating
8	Push Button	Two (2) of each type and rating
9	Contactors	One (1) of each type and rating
10	Receptacles	One (1) of each type and rating



ANNEXURE – B

LIST OF DRAWINGS

Sl. No.	DRAWING NOS.	DESCRIPTION
1	18A09-CHM-DWG-E-0002	POWER DISTRIBUTION DIAGRAM OF CHIMNEY
3	18A09-DWG-E-0400	CABLING NOTES & DETAILS
4	18A09-DWG-E-0600	GROUNDING NOTES AND DETAILS
5	18A09-DWG-E-0800	ILLUMINATION NOTES AND DETAILS
6	18A09-DWG-E-1000	LIGHTNING PROTECTION NOTES AND DETAILS



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION-III
SUB-SECTION-II
TECHNICAL SPECIFICATION
A.C. MOTORS**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
Sub-section-II
A.C. Motors**



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VOLUME: II-B

SECTION-III

SUB-SECTION-II

A.C. MOTORS

1.00.00TYPE

1.01.0 A.C. Motors

- 1.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.
- 1.01.02 The motor shall be self-ventilated type, with TEFC / TETV cooling, depending on requirement and rating.
- 1.01.03 All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity.
- 1.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615..
- 1.01.05 The motor name plate rating at 50⁰C shall have at least 15% margin for LT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.
- 1.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

2.00.00 PERFORMANCE

2.01.00 Running Requirements

- 2.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 2.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

2.02.00 Starting Requirements





- 2.02.01 For LT motors the starting current shall be as per the limit mentioned in the relevant standard with IE-3 efficiency class. For D.C. Motors the starting current shall be limited to 2 times full load current.
- 2.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- 2.02.03 All motors (except mill motors) shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals without exceeding acceptable winding temperature.
- 2.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.
- 2.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.
- 2.02.06 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 2.02.07 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 2.03.00 **Locked Rotor Withstand Time**
- 2.03.01 For motors with starting time up to 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.
- For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.
- For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time.
- 2.03.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.
- 2.03.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.



2.04.00 **Torque Requirements**

2.04.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

2.04.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

3.00.00 **SPECIFIC REQUIREMENTS**

3.01.00 **Enclosure**

3.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction. Separate Canopy shall be provided for LT motors located in outdoor or semi-outdoor area.

Motors, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

3.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

3.02.00 **Winding and Insulation**

3.02.01 All insulated winding shall be of copper. Windings shall be impregnated to make them non-hygroscopic, flame resistant and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

3.02.02 Motors shall have Class F or higher insulation with temperature rise limited to 120°C.

3.03.00 **Tropical Protection**

3.03.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

3.03.02 All fittings and hardwares shall be corrosion resistant.

3.04.00 **Bearings**

3.04.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

3.04.02 Vertical shaft motors shall be provided with thrust and guide bearings.

3.05.00 **Noise & Vibration**

3.05.01 The noise level shall not exceed 85 db (A) at 1.0 meters from the motor.





- 3.05.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.
- 3.06.00 **Motor Terminal Box**
- 3.06.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.
- 3.06.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90 Deg., unless otherwise approved.
- 3.06.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.
- 3.06.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (415V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.
- 3.06.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 3.06.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 3.06.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.06.08 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 3.06.09 The gland plate for single core cable shall be non-magnetic type.
- 3.07.00 **Grounding**
- 3.07.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.
- 3.07.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:
- | | | |
|-----------------------------|---|-------------------|
| Motor above 90KW | : | 50 x 6 mm GS Flat |
| Motor above 30KW up to 90KW | : | 35 x 6 mm GS Flat |
| Motor above 5KW up to 30KW | : | 25 x 3 mm GS Flat |
| Motor up to 5KW | : | 8 SWG GI Wire |





3.07.03 The cable terminal box shall have a separate grounding pad.

3.08.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection (IP No.).
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

4.00.00 **ACCESSORIES**

4.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

4.02.00 **Space Heater**

4.02.01 Motor of rating 30KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

4.02.02 The space heater shall be rated 240V, 1 phase 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

4.03.00 **Accessory Terminal Box**

4.03.01 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.

4.04.00 **Drain Plug**

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

4.05.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

4.06.00 **Dowel Pins**





The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

4.07.00 Painting

Motor including fan shall be painted with corrosion proof paints.

5.00.00 TESTS

5.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS. In addition, any special test called for in the driven equipment specification shall be performed.

5.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the dispatch of the motors from works.

5.03.00 The following type test reports shall be submitted for each type and rating of 11 kV & 3.3 kV motor:

- a) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- b) Fault level withstand test for each type of terminal box.
- c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.
- d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

5.04.00 SPARES

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

06.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

06.01.00 Along with the bid

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write up on forced lubrication system, if any
- d) Type test report





06.02.00 **After Award of the Contract**

- a) Dimensional General Arrangement drawing
- b) Foundation Plan & Loading
- c) Cable end box details
- d) Space requirement for rotor removal
- e) Thermal withstand curves hot & cold
- f) Starting and speed torque characteristics at 80% & 100% voltage
- g) Complete motor data
- h) Erection & Maintenance Manual
- i) Efficiency curves.
- j) List of motors.
- k) Test reports



ANNEXURE – A

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
L.T. Supply	415V, 3 \emptyset /, 3W, 50 Hz Effectively earthed Fault level 50 KA sym. for 1 seconds.	Motors above 200W upto 160 kW
	240V, 1 \emptyset /, 2W, 50 Hz Effectively earthed	Motors below 200W Lighting, space heating, A.C. control protective devices

2.0 RANGE OF VARIATION

A.C. Supply

Voltage : $\pm 10\%$

Frequency : $\pm 5\%$

Combined Volt & frequency : 10% (absolute sum)



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
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**VOLUME: II-B
SECTION-III
SUB-SECTION-III
TECHNICAL SPECIFICATION
POWER DISTRIBUTION BOARD**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
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Power Distribution Board**



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SUB-SECTION-III

POWER DISTRIBUTION BOARD

1.00.00 SCOPE OF SUPPLY

1.01.00 The following equipment shall be furnished complete with all accessories:

- a) Main Power Distribution Board (MPDB) : One (1)
no.
- b) Emergency Power Distribution Board (EPDB) : One (1)
nos.

1.02.00 Base channel frame of all boards along with necessary mounting hardware.

1.03.00 Mandatory spares.

1.04.00 All relevant drawings, data and instruction manuals.

2.00.00 GENERAL NOTES

2.01.00 MPDB shall feed power to Elevators, Lighting Distribution Board (LDB), Emergency Distribution Board, Power Receptacles and other load requirement.

2.02.00 Emergency Power Distribution Board (EPDB) shall feed power to Aviation Lighting Panel (ALP) & Emergency Lighting Panel.

3.00.00 SYSTEM CONCEPT AND DESIGN CRITERIA

3.01.00 MPDB shall supply auxiliary power for normal operation.

3.02.00 The equipment will be located in a hot, humid, and tropical atmosphere, heavily polluted.

3.03.00 Busbars of DBs shall be sized to carry continuously the total running load of the DB (including anticipated future load, wherever applicable) plus a 20% margin.

3.04.00 In-cubicle ratings of incomer and bus-section breakers shall be identical to the associated busbar rating.





- 3.05.00 Incomers rated up to and including 400A shall be MCCB/ switch controlled. Above 400A, all incomers and feeders shall be breaker controlled.
- 3.06.00 20% spare feeders with minimum one (1) no. of each type and rating shall be provided.
- 3.07.00 MPDB & EPDB shall be provided with an adequately rated dry type, delta/star, transformer with Dyn11, $\pm 2 \times 2.5\%$ Tap, 415V / 415V. The star point of the secondary side shall be solidly grounded to get 3 phases, 4 wire supplies.

The dry type transformer shall have the following properties:

Type	:	Cast Resin Dry Type
Voltage rating	:	415/415V
Cooling	:	AN
Impedance	:	As per IS
Voltage Control	:	Off load
Class of Insulation	:	F
Temperature rise over 50° C ambient	:	70° C
Neutral	:	Solidly Grounded
Mounting	:	Inside main Lighting Distribution Board

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 Construction

- 4.01.01 DBs shall be indoor, air insulated, and metal-clad type. The design construction shall be such as to permit extension at either end.
- 4.01.02 DBs shall be floor-mounting type & Single front construction.
- 4.01.03 All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.

Frame shall be enclosed in cold rolled sheet steel of thickness not less than 2mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.





- 4.01.04 DBs shall be fully compartmentalized with metal/ insulating partitions between compartments. Working height shall be limited between 450mm and 1800mm from floor level.
- 4.01.05 All doors and covers shall be neoprene gasketed.
- 4.01.06 For DB modules, all push-buttons, lamps, and indicating instruments shall be flush/semi-flush mounted on respective module compartment.
- 4.01.07 Four (4) Nos. lifting lugs shall be provided for each section, two (2) nos. on either end of the section.
- 4.01.08 The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars shall be 25mm. For all other components, the clearance between two live parts, a live part and an earthed part, and isolating distance shall be at least 10mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by barriers. However, for horizontal and vertical busbars, the clearances mentioned above should be maintained even when these are sleeved or insulated. All connections from busbars shall be fully shrouded to minimize the risk of phase to phase and phase to earth shorts.
- 4.02.00 **Bus and Bus Taps**
- 4.02.01 All busbar compartments shall be completely enclosed. Horizontal and vertical busbars and bus connections shall be of high conductivity Aluminium/ Aluminium alloy.
- The maximum temperature of busbars and bus connections shall be limited to 55°C with silver plated joints and 40°C with all other types of joints over an ambient of 50°C.
- No diversity factor shall be allowed for temperature rise.
- 4.02.02 Vertical busbars shall be designed for a minimum current rating of 200 A.
- 4.02.03 All bus connections shall be provided with anti-oxide grease. Adequate contact pressure shall be ensured by means of two-bolt connection with plain and spring washers and locknuts.
- 4.02.04 Bimetallic connectors shall be provided for connections between dissimilar metals.
- 4.02.05 All busbars and bus connections shall be fully insulated for working voltage. Insulating heat shrinkable sleeves shall be provided for all busbars. All joints and tap-off points shall be shrouded.
- 4.02.06 Bus insulators shall be non-hygroscopic, flame retardant, track resistant, high strength, sheet molded compound or equivalent polyester fibreglass molded type. Separate supports shall be provided for each phase and neutral busbar.





- 4.02.07 Cross-section of the busbars shall be uniform throughout the length of the assembly. All busbars and bus connections shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.
- 4.02.08 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left-to-right, top-to-bottom, or front to rear when viewed from the front of the assembly.
- 4.02.09 Bolted disconnecting links shall be provided for all incoming and outgoing feeders for isolation of neutral, if necessary.
- 4.03.00 **Terminal Blocks**
- 4.03.01 Terminal blocks shall be 1100V grade box-clamp type 10-mm² minimum with marking strips.
- 4.03.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished and these spare terminals shall be uniformly distributed on each terminal blocks.
- 4.04.00 **Cable Termination**
- 4.04.01 Generally, all assemblies shall be designed for cable entry from the bottom. Sufficient space shall be provided for all the cables as per cable schedule, for ease of termination and connection.
- 4.05.00 **Ground Bus**
- 4.05.01 A ground bus, rated to carry maximum fault current, shall be provided which shall extend the full length of the assembly.
- 4.05.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end and shall be suitable to receive 50 x 6 mm G.S. flat.
- 4.06.00 **Nameplates**
- 4.06.01 Nameplates of approved design shall be provided on each cubicle, at the top of the assembly and on each instrument & device mounted on or inside the cubicle.
- 4.06.02 The material shall be lamicaid or approved equal. 3 mm thick with white letters on black background.
- 4.07.00 **Tropical Protection**
- 4.07.01 All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.
- 4.08.00 **Moulded Case Circuit Breaker (MCCB)**
- 4.08.01 Moulded Case Circuit Breaker (MCCB) shall be three pole, single throw, air break type having trip free mechanism with quick make, quick break contacts.





MCCB shall have current limiting design.

MCCB of identical rating shall be physically and electrically interchangeable.

Each MCCB shall be provided with 1 NO and 1 NC electrically separate auxiliary contacts.

4.08.02 MCCB for motor feeders shall have adjustable short circuit release. MCCB used for 50KW and above motor rating shall have additional E/F protection.

4.09.00 **Miniature Circuit Breaker (MCB)**

4.09.01 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

4.10.00 **Painting**

4.10.01 All assemblies shall be finished in light grey (IS shade * 631) with two coats of synthetic enamel paint. Painting process shall be of powder coating type.

5.00.00 TESTS

5.01.00 The item shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION-III
SUB-SECTION-IV
TECHNICAL SPECIFICATION
ILLUMINATION**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
Sub-section-IV
Illumination**



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VOLUME: II-B
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ILLUMINATION SYSTEM

1.00.00 SCOPE OF SUPPLY

1.01.00 The work involves timely procurement and transportation to site in properly packed condition of all equipment, materials and miscellaneous items required to complete the project.

1.02.00 The equipment and materials within the scope of supply shall include but not limited to:

- a) Lamp and LED type lighting fixtures and related LED accessories.
- b) Lighting panels/ boards: All panels shall be provided with energy saving system.
- c) Street light poles.
- d) Receptacles, switches, switchboards, portable emergency lights etc.
- e) Cables, wires, splicing/termination/connection accessories including 4 way/3 way/2 way cable junction boxes with disconnecting devices on each way.
- f) Conduit and accessories, junction and pull boxes, terminal blocks.
- g) Grounding materials and connections.
- h) All fittings, supports, brackets, anchors, clamps and connections.
- i) Steel for field fabrication of supports and brackets.

1.03.00 Carrying out of detail engineering, including detail design calculations, preparation of lighting layouts showing location of fixtures, cable, wires conduit routing, indicating number and size of wires in each conduit and preparation of cable schedule and other related drawings as detailed in subsequent clauses consider the energy saving and energy efficient illumination system.

1.04.00 Preparation of "As built" drawings at the option of owner.

1.05.00 Special tools and tackle.





2.00.00 SYSTEM CONCEPT

2.01.00 Aviation Warning Lights

2.01.01 In accordance with ICAO regulations and Director General of civil aviation India requirements, aviation warning lights are required to be provided at various levels of Chimney along its perimeter. Suitable photo-electric sensors, alarm and annunciation systems, etc. shall also be provided along with the required auxiliaries for completing the system in all respects.

2.01.02 The number of obstruction lights to be installed at specified level shall be such that the obstruction is indicated from every angle in the azimuth. Fixtures on each level shall be arranged at the same elevation and with equal radial spacing around the Chimney. The life of AOLs shall be more than 10 years and shall have corrosion resistant aluminum casting finished in stove enameled control gear suitable for 200/240V, 50Hz supply, complete with all accessories.

2.01.03 The AOL system shall be provided with Photoelectric light detectors to monitor north sky for controlling the aviation warning lights. The lights should not be switched off for momentary increases in light intensities due to lightning flashes or any other short bursts of light. The detectors should be complete with all the accessories, hardware etc. necessary for installation. The facility for Auto/Manual operation shall be provided. AOL distribution board shall be fed from emergency power distribution board (EPDB).

2.01.04 The aviation warning lights shall be high power light emitting diodes (LED) and to be installed on Chimney shall be as follows:

- Medium intensity (>1600 cd) red flashing lights (20-60 flashes per minute- adjustable) above height of 61 M upto 150M.
- Low intensity (>10 cd) steady lights below 61 M

The top most lights shall be placed between 3M to 5M below the top of Chimney and the rest at each platform level. The lights shall be spaced equally with minimum four (4) numbers around the Chimney.

2.01.05 The aviation warning lights shall be adequately secured to the Chimney against wind forces and shall be mounted so that they are accessible for lamp replacement and cleaning.

2.01.06 The lighting system shall be energized through an adjustable timer (0-24 hrs.). The timer shall cause the control unit to energize and de-energize the aviation lighting system automatically as per the preset time. In addition auto-manual selection with manual ON-OFF facility of the lights shall be provided in the control unit.

2.01.07 LED lamps should be maintenance free long life LEDs (Having a life of





1000,000 hours or more at the rate of 12 hours burning per night).

- 2.01.08 Since the LEDs have a directional light intensity and individual LEDs of high intensity have not been developed, the bidder has to use a columnar array of LEDs, such column being placed in a circular configuration, each column totaling the minimum intensity requirement at all times during its life. Bidder has to guarantee the same.
- 2.01.09 All the Luminaries should have IP 65 protection.
- 2.01.10 Enclosure should be designed in such a way that the temperature inside the enclosure should be maintained as low as possible to arrest frequent LED failures. The body must be of corrosion resistant silicon aluminum alloy or equivalent.
- 2.01.11 The design of the LED circuitry should be such that the rated current does not exceed 60% of the maximum forward current specified for the LED and also take into account the derated value of the maximum current rating at the ambient temperature.
- 2.01.12 Surge protection should be provided by Metal Oxide Varistors.
- 2.01.13 Electrical test for high wattage dielectric at 1.5 KV for one minute, insulation resistance at 500 V DC and total wattage consumption has to be carried out at the time of inspection.
- 2.01.14 Light Intensity measurement has to be carried out.
- 2.01.15 All LEDs should be in series-parallel strings and should have EMI/ RFI Filters.
- 2.01.16 Flasher synchronization control and monitoring controller for medium intensity LED lights should be as per ICAO recommendation and all lights must flash together i.e. synchronously.
- 2.01.17 Bidder has to design the circuit to sense the current flow of each light and also to guard against any light being operated in a steady condition.
- 2.01.18 A controller has to be provided for each installation to monitor constantly the functioning of all lights. The controller should have the following features:
- Current sensor and indicator for each light, by means of an LED-based indicator.
 - Fuse for each light with corresponding MCB.
 - All the light to be fed by a common flasher unit for synchronous flashing.
 - Standby flasher unit.
 - Active warning and shut-off circuitry, with audio indicator and





automatic shut-off of power feed to AOL units in case of Flasher failure.

- Flasher Diagnostic by-pass switch.
- Photoelectric switch unit with amplifier activating a solid-state relay.
- Mimic on front fascia for diagnostic purpose.

2.01.19 A warranty of minimum five (05) years has to be provided by the manufacturer for this LED Aviation lights.

2.01.20 The flasher unit of the aviation light has to be indoor mounted. It should not be mounted at the AOL unit level, or in an outdoor environment.

2.02.00 **Temporary Aviation Warning Lights**

2.02.01 Bidder shall provide Temporary Aviation Warning Lights (with red flashing medium intensity LED type AOL conforming to ICAO guide lines) during construction above the 45M level from general ground level.

2.02.02 Temporary aviation warning lights shall be four fixtures (minimum intensity not less than 10 foot candles) LED type, located in a horizontal plane on the Chimney structure to ensure unobstructed visibility of at least one aviation warning light from aircraft at any normal angle of approach. Power for operation of the temporary aviation warning lights shall be obtained from the construction power system. Supply circuits for these lights shall be furnished, installed and maintained by the Contractor.

2.02.03 Temporary aviation warning lights shall be operated at night i.e from sunset to sunrise.

2.02.04 These lights shall continue to exist till permanent arrangement of lights are completed.

2.03.00 **Interior And Exterior Lights**

2.03.01 Exterior platforms and staircase shall be illuminated by approved industrial well glass luminaries with 150 W HPSV lamp and separate control gearbox. At least two (2) fixtures on each platform level shall be fed from aviation warning lighting board (emergency source). All staircase lights shall also be fed from emergency system.

2.03.02 Necessary junction boxes with MCBs shall be provided on each platform to control the platform and staircase lights.

2.03.03 One (1) 6/16A, 240V, single phase industrial, weatherproof type, suitable for wall/ column mounting, 3-pin receptacle (Best & Crompton make or approved equivalent) with suitable interlock shall be provided on each internal and external platform. At least two 63A, 415V, three phase industrial,





weatherproof type, 5-pin receptacles shall be provided at the internal platforms.

2.03.04 Chimney Rack & Pinion Lift Room

Industrial fluorescent luminaries with 2X40W fluorescent lamps with reflector shall be provided for Chimney Rack & Pinion Lift Room.

2.04.00 Street/Area Lighting

Time switch will be used for controlling area/outdoor/ yard lights with provision for manual override and also have the provision of proven Energy Saving Systems.

3.00.00 RATINGS & REQUIREMENTS

3.00.01 All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.

3.00.02 Switch, fuses, MCCB, miniature circuit breakers (MCB), busbar shall be fully rated for short circuit level at the point of application. MCB shall have back-up HRC fuse if its rating is less than the available short circuit current.

3.00.03 All equipment and accessories shall have proper enclosure to suit the site conditions. In hazardous areas all equipment and accessories shall have flame-proof enclosure.

3.00.04 Lighting wires shall have stranded copper conductor PVC insulated, 1100 V grade, laid in galvanized G.I. conduits and shall be of following minimum sizes:

- From Lighting panels to junction boxes : 6 SQ.mm
- From junction boxes to lighting fixtures : 2.5 SQ.mm
(No. of wires per lead as required)
- From Lighting panels to receptacles (6/16A) : 6 SQ.mm

3.00.05 Heavy duty XLPE, FRLSH power cables as per IS 7098 will be used for connections from Main power Distribution Board to Lighting Panel, from Emergency power Distribution Board to Emergency Lighting Panels (ELP) & from Street/Area lighting panel to street light poles.

3.00.06 Voltage drop at the fixture end from the Main power distribution board/Emergency power distribution board bus shall not exceed 3%.

3.00.07 Circuit loading of each lighting Panel shall be done as per relevant codes/Indian Standards in such a way that almost balanced loading in all the phases i.e. R, Y & B is achieved.





- 3.00.08 At least two (2) sub circuits shall be used for illumination of a particular area.
- 3.00.09 Sub circuit loading of each lighting panel shall be restricted to 2000 Watts.
- 3.00.10 The working plane shall be considered at 0.85 m from the floor level.
- 3.00.11 Calculation can be done through proven software program by maintaining uniformity ratio as per relevant IS.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 Equipment and Material

- 4.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.
- 4.01.02 Equipment and materials furnished shall be complete and operative in all details.
- 4.01.03 All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.
- 4.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

4.02.00 Lighting Fixtures

- 4.02.01 Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive, scratch resistant and no bright spots are produced either by direct light source or by reflection. Fixture shall conform to latest IS / IEC and its latest amendment
- 4.02.02 All lighting fixtures shall be complete with LED (energy efficient type). LED lamp fixtures shall be complete with all necessary wiring such as control gear & it's accessories ignitor, power factor improvement capacitors (if required) etc. These shall be mounted in the fitting assembly only. The Contractor shall indicate starting time of these lamps to attain full light output. Curves for starting characteristics with varying supply voltage etc. are to be furnished by the Contractor.
- 4.02.03 Fixture shall be suitable for 20 mm conduit entry and 16 SWG G.I. earth wire connection.
- 4.02.04 Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.

4.02.05 Lamp holders





Lamp holders shall be for LED lamp. Holders shall be designed and manufactured in accordance with relevant standard to give long and satisfactory service.

4.03.00 **Lamps**

The LED lamps to be supplied shall conform to IS 9974 or latest edition. LED lamps shall be suitable for use in any position.

4.04.00 **Lighting Panel**

4.04.01 Lighting panels shall be metal-enclosed, cabinet type, fabricated from CRCA sheet steel minimum 2 mm thick, suitable for either wall/column mounting on brackets or floor mounting on channel sills.

4.04.02 Indoor Lighting Panels shall be dust and vermin-proof (IP-52); outdoor panels shall be weather-proof with canopy (IPW-55 or better).

4.04.03 Lighting Panels shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.

4.04.04 Lighting panels shall have provision of cable entry from top and bottom (as required) with removable gland plates. Necessary double compression type brass cable glands, tinned copper/Aluminium cable lugs are to be furnished.

4.04.05 Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Panel for connection to ground conductor.

4.04.06 Each Lighting Panel shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of each circuit. The plates shall be of anodized aluminium with inscriptions indelibly etched on it.

4.04.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85°C. Minimum size shall be 25 x 6 mm.

4.04.08 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.

4.05.00 **Panel Equipment**

4.05.01 Each panel shall have an incoming triple pole MCCB with neutral link and a number of outgoing miniature circuit breakers (MCB).

4.05.02 Panel access door shall be interlocked with incoming MCCB such that the door can be opened only when the MCCB is in OFF position. Means shall be provided to defeat this interlock.





- 4.05.03 All MCCB shall be single throw, air break, heavy duty type having quick-make quick-break contacts. Contactors shall be air break electromagnetic type. Push buttons shall be push to actuate type.
- 4.05.04 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.
- 4.05.05 Time switch in street lighting panels shall be clock switch type with ON-OFF time setting facility, which shall ensure respective ON-OFF operation in every 24 Hours cycle. Voltmeter/Ammeter shall be of accuracy class 2.0 or better as per IS: 1248. Each indicating meter shall be provided with selector switch.
- 4.06.00 **Receptacle**
- 4.06.01 Receptacles shall be heavy duty, complete with individual plug and switch as detailed in the annexure. For Residential building, Electrical room, Pump room, Control Room 16/6 Amp receptacles shall be considered.
- 4.06.02 The conduit box of the receptacle shall be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG G.I. wire. Arrangement shall be provided inside the conduit box for grounding of third pin.
- 4.06.03 Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.
- 4.06.04 Minimum two (2) nos. of 63 Ampere three phase four pin receptacles shall be provided at each elevation of Chimney and also at major area.
- 4.08.00 **Switch & Switch Board**
- 4.08.01 All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6 mm thick colour matching FRP/ Non- Hygroscopic Synthetic cover with brass fixing screws.
- 4.08.02 Switch boards/boxes located in electrical room shall be flush mounted type on brick wall with switch knob projecting outside.
- 4.08.03 Switch boards/boxes shall have conduit knock outs on the sides. Adequate provision shall be made for ventilation of these boxes.
- 4.08.04 Flush type receptacles where provided shall be so located that only the plug projects outside.
- 4.08.05 Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.
- 4.09.00 **Lighting Poles**

Street Light Poles





- a) Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.
- b) The pole shall be coated with bituminous preservative paint on inside as well as embedded outside surface. Exposed surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in synthetic medium).

4.10.00 **Maintenance Equipment**

4.10.01 The Bidder shall supply one (1) no. of wheel mounted adjustable aluminium ladder for the maintenance of street lights.

4.11.00 **Special Requirement**

4.11.01 All outdoor illumination fixtures, unless it is fed from photo cell/time switch controlled lighting panel, has to be provided with outdoor type local switches.

4.12.00 **Lighting Cables & Wires**

4.11.01 Lighting Cable shall be heavy duty, 1100 Volt grade, multicore stranded copper conductor, XLPE insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed with FRLSH conforming to IS 1554.

4.11.02 Lighting wires shall be 1100 Volt grade, PVC insulated, stranded conductor, single core cable conforming to IS 694, colour coded as below :

RED	for	R-Phase	BLUE	for	B-Phase
YELLOW	for	Y-Phase	BLACK	for	Neutral

4.12.00 **Nameplate**

Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English as to clearly indicate their functions.

All lighting fixtures, receptacles, fans, junction boxes etc. shall be properly marked up indelibly with corresponding circuit numbers.

4.13.00 **Grounding**

4.13.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.

4.13.02 Ground connections shall be made from ground grid. All connections to ground grid shall be done by arc welding.





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- 4.13.03 Lighting Panels shall be directly connected to ground grid by two nos. 35 x 6 mm G.S flats.
- 4.13.04 Street lighting Pole shall be grounded at two points by two nos. 50x6 mm G.I flat risers from two (2) nos. earthing spike 40 mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2) nos. earthing terminals by 16 SWG GI wire.
- 4.13.05 One 16 SWG G.I wire shall be taken up to the junction box from lighting fixtures and connected to grounding point.
- 4.13.06 A continuous ground conductor of 16SWG GI Wire shall run along each exposed metallic conduit run and bonded to it every 600 mm by not less than two turns of the same size of wire. This conductor shall be connected to each panel ground bus.

All junction boxes, receptacles, fixtures etc. shall be connected to this 16 SWG ground conductor.





Annexure-A

AVAILABLE POWER SUPPLY

1.0 System Voltage

Lighting equipment and accessories shall be designed for satisfactory operation from the following power supply sources:

1.1 A.C. Supply : 415 Volt, 3 phase, 50 Hz, 4 wire effectively grounded system.

Fault Level 50KA (r.m.s. symmetrical).

2.0 Permissible Variation

Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variations as listed below:

2.1 A.C. Supply : Voltage $\pm 10\%$
Frequency $\pm 5\%$
Combined Voltage 10% (absolute sum)
+ Frequency



Annexure-B

AVERAGE LUX LEVEL FOR DIFFERENT AREAS

Sl. No.	Location	Lux Level
1.	Switchgear/MCC/Electrical Equipment Rooms	250
2.	Street & periphery lighting	20
3.	Office Rooms	250

Medium bay fixtures shall be used where the room height is 8 M. Otherwise high bay fixtures are to be used.

- Lux level for A.C. Emergency lighting in control room shall be 50 and for other areas 20 lux.
- Lux level for main road lighting shall be 20lux and for secondary road shall be 10 lux.
- If Lux level of any specific area is not covered in above table, Vendor shall take specific confirmation from purchaser before finalization of Bid.



Annexure-C

TYPE OF FITTINGS/FIXTURES AND OTHER AUXILIARIES

1.0 LIGHTING FIXTURES & LAMPS

Each lighting fixture shall be furnished complete with associated lamp, holder and all accessories as required.

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.1	ILD-1	BN108C LED 20S PSU CDL WH	Commercial/decorative type, Surface/ pendant mounted green perform LED Batten [system flux \geq 2000 lumens, 6500K color temperature, CRI \geq 75, System efficacy $>$ 100lm/W] having minimum lifetime of 40,000 burning hours (at L70) with PC glossy diffuser. The luminaire shall be made up of CRCA sheet steel (IP20) with THD $<$ 10% and PF $>$ 0.9, similar to Philips make ENDURALED BATTEN "BN 108C LED 20S PSU CDL WH.	Swgr room / MCC room / Workshop / Maint. Shop / Office / Toilet / Corridor / Pantry / Stores
1.2	ILD-3	RC869B LED 30S 6500 W30L120 D8 GR	Decorative type, recess mounted green perform LED Batten [system flux \geq 3000 lumens, 6500K color temperature, CRI \geq 70, System efficacy \geq 100 lm/W] having minimum lifetime of 40,000 burning hours (at L70) with high purity anodized aluminium mirrors. The luminaire shall be made up of CRCA sheet steel (IP20) with THD $<$ 10% and PF $>$ 0.9, similar to Philips make SERENO "RC869B LED 30S 6500 W30L120 D8 GR".	False Ceiling areas (Control Room / Electronic Eqpt. Room / Office / Conference room / Engineer's Room / Corridor)
1.3	OLD-1	BRP022 LED 21 CW MR S1 PSU GR	Pressure Die cast aluminium frame (IP 65) , dust free type, green perform LED Batten [system flux \geq 2100 lumens, 5500K color temperature, CRI \geq 70, System efficacy \geq 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70).The luminaire shall have inbuilt surge protection ($>$ 2KV) with THD $<$ 20% and PF $>$ 0.95, similar to Philips make BRP022 LED 21 CW MR S1 PSU GR LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Building exterior lighting / Outdoor area lighting / Outdoor eqpt. Area
1.4	OLD-2	BRP410 LED CW 072 MR FG S1 PSU GR	Pressure Die cast aluminium frame (IP 65) with heat resistance toughened clear glass, dust free type, green perform LED Batten [system flux \geq 7200 lumens, 5500K color temperature, CRI \geq 70, System efficacy \geq 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD $<$	Street lighting / boundary lighting





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SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
			20% and PF > 0.95, similar to Philips make BRP410 LED CW 072 MR FG S1 PSU GR. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	
1.5	OLD-3	BRP322 LED 128 CW HE MR FG S3 XT	Pressure Die cast aluminium frame (IP 65) with heat resistance toughened clear glass, dust free type, green perform LED Batten [system flux \geq 12800 lumens, 5500K color temperature, CRI \geq 70, System efficacy \geq 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 20% and PF > 0.95, similar to Philips make BRP322 LED 128 CW HE MR FG S3 XT. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Street lighting / boundary lighting
1.6	OLD-4	BVP 120 LED 70 CW NB FG S3 XT	Pressure Die cast aluminium frame (IP 65), Compact, sturdy, dust free type, green perform LED Batten [system flux \geq 7000 lumens, 5500K color temperature, CRI \geq 70, System efficacy \geq 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95, similar to Philips make BVP 120 LED 70 CW NB FG S3 XT. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Area lighting / Yard lighting / Floodlighting purpose
1.7	OLD-5	BVP122 LED 146 CW NB FG XTFC	Pressure Die cast aluminium frame (IP 66), Compact, sturdy, dust free type, green perform LED Batten [system flux \geq 14600 lumens, 5500K color temperature, CRI \geq 70, System efficacy \geq 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95, similar to Philips make BVP122 LED 146 CW NB FG XTFC. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Area lighting / Yard lighting / Floodlighting purpose





SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.8	OLD-6	BVP 120 LED 70 CW NB FG S3 XT	Pressure Die cast Aluminium frame (IP 65), Compact, sturdy, dust free type, green perform LED Batten [system flux \geq 7000 lumens, 5500K color temperature, CRI \geq 70, System efficacy \geq 90 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection ($>$ 2KV) with THD $<$ 20% and PF $>$ 0.95, similar to Philips make BVP 120 LED 70 CW NB FG S3 XT. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Area lighting / Yard lighting / Floodlighting purpose

Note 1: The supply also includes associated junction boxes, brackets, supports, hangers, and wires wherever applicable.

2.0 LIGHTING PANEL

2.1 LP-1 415 V A.C. Indoor type Lighting Panel with 415 V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch/MCCB as incomer, 24 nos. 20A, 240 V, 1 pole MCBs as outgoing feeders.

2.2 LP-2 415 V A.C. Indoor type Lighting Panel with 415 V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch/MCCB as incomer, 18 nos. 20A, 240 V, 1 pole MCBs as outgoing feeders.

2.3 LP-3 415 V A.C. Indoor Lighting panel with 415 V, 3ph, 4W bus & one 63A TP & N Switch/MCCB as incomer and 12 nos 20A , 240V 1 pole MCBs as outgoing feeder.

2.4 LP-4 415V A.C. Indoor type Lighting Panel with 415V, 63A, 3 ph, 4 wire bus, one (1) no. 32 A TP & N switch/MCCB as incomer, 6 nos. 20A, 240V, 1 pole MCBs as outgoing feeders.

2.5 SLP 415 V A.C. Outdoor type Panel with 415 V, 100A, 3 ph, 4 wire bus, one 100A TP & N switch/MCCB as incomer, 18 nos. 20A, 240V, 1 pole MCBs as outgoing feeders.

The lighting panel shall be provided with 63A contactor, frequency compensated timer switch, photo-cell switch push- buttons for automatic control of street/area lighting with provision for manual override.

2.6 FLP Outdoor, lockable type Isolating switch of 415V, 63A, 3 ph, 4 wire TP & N. with 2 mm sheet steel/cast iron cubicle.





3.0 RECEPTACLE

- 3.1 RA 6A, 240 V, 2 pole, 3 pin with third pin earthed, suitable for flush mounting in office areas and control room. The switch shall be also flush mounted piano type. Degree of protection shall be IP 52 (for Indoor) / IP 65 (for outdoor).
- 3.2 RB 16A, 240V, 2 pole, 3 pin with third pin earthed, wall/ column mounted, metal clad gasketed construction, 20mm conduit entry, screwed metal cover tied to it by a metal chain, weatherproof suitable for indoor/outdoor installation. Degree of protection shall be IP 52 (for Indoor) / IP 65 (for outdoor).
- 3.3 RC 63A, 415 V, 3 phase, 4 pin interlocked plug and switch with earthing contact, wall/column mounted, metal clad gasketed construction, weatherproof, suitable for loop-in/loop-out connection of 4/C-35 Sq.mm XLPE cable. These shall be fed from AC Distribution Board/Station MCC. Degree of protection shall be IP 52 (for Indoor) / IP 65 (for outdoor).
- 3.4 RD 125 A, 415 V, 3 phase 5 pin interlocked plug & switch with fifth pin earthed, wall/column mounted metal clad gasketed construction, weatherproof, suitable for loop in and loop out connection of 3-1/2C -95 Sq.mm XLPE cable. These shall be fed from A.C-Distribution Board/Station MCC. Application at all Transformer Yard for Oil Filtration machines and other areas. Degree of protection shall be IP 65.

4.0 CEILING FANS

- 4.1 FA 1200 mm sweep ceiling fan with regulator, down rod and canopy.
- 4.2 FB 1400 mm sweep ceiling fan with regulator, down rod and canopy.

5.0 LIGHTING POLES

- 5.1 TA/TB Single arm/double arm swaged and welded steel pole with junction box and all accessories.

6.0 SWITCHBOARD

- 6.1 S-1 Switch board with 1-6A switch.





6.2 S-2 Switch board with 3-6A switch and 1-6A receptacle.

6.3 S-3 Switch board with 6-6A switch and 1-6A receptacle.

7.0 MISCELLANEOUS ITEMS

7.1 M1 10 m high car wheel mounted aluminium ladder.

7.2 M2 Adjustable free-standing aluminium ladder height adjustable from 5 m to 10 m.+

7.3 M3 Portable Emergency light set complete with one 20W tube light, battery, battery charger and all other accessories.



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Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION-III
SUB-SECTION-V
TECHNICAL SPECIFICATION
CABLES**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
Sub-section-V
Cables**



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SECTION-III
SUB SECTION-V
CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Cables shall be furnished in accordance with this specification and the following annexures: -

- a. LV. Power Cables : Annexure A
- b. Control Cables : Annexure B

1.02.00 Other cables including special cables, fire survival cables if any, which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and sub-systems.

1.03.00 Special tools and tackle.

2.00.00 DESIGN CRITERIA

2.01.00 The Cables will be used for connection of power and control circuits of the auxiliary electrical systems.

2.02.00 Cables will be generally laid on ladder type trays or drawn through conduits or directly buried in ground depending on layout requirement.

2.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard or this specification which one is more stringent.

2.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

2.05.00 The outer sheath of power and control cables shall have rodent and termite repulsion treatment.

2.06.00 Core identification for multicore cable shall be provided by colour coding.

2.07.00 The allowable voltage drop at terminal of the connected equipment shall be maximum 2.5% at full load while choosing the conductor size and calculations shall be submitted for purchaser's approval. In case of squirrel cage induction





motors, the cable size shall be so chosen that the motor terminal voltage does not fall below 80% of the rated voltage, at the time of starting.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 L.V. Power Cables

The type and quantity shall be furnished as indicated in Annexure -A

3.02.00 Control Cables

The type and quantity shall be furnished as indicated in Annexure -B

3.03.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:

- a) Manufacturer's name or trade mark
- b) Voltage grade
- c) Year of manufacture
- d) Type of insulation, e.g. XLPE/PVC etc.
- e) No. of core and size of cables.
- f) Type of improved fire performance, e.g. FR/FR-LSH
- g) IS number

4.00.00 TESTS

The Cables shall be subject to shop tests in accordance with relevant IS/IEC standards to prove the design and general qualities of the Cables.



Annexure-A

LV POWER CABLE

- 1.0 1100 V grade, 90° C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 for cable sizes above 2.5 mm² and class 2 stranded high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS:7098 (Part-3)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded PVC compound conforming to type ST2 of IS:5831 for multicore cable. Single core cables shall have no inner sheath.
- 1.5 Armour : Galvanised single round steel wire armour for twin and multicore cables.
Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
- 1.6 Overall Sheath : Extruded FRLS PVC compound conforming to type ST2 of IS:5831. having improved fire performance category and type as stated below.
- | Category | Type |
|----------|--|
| C2 | FRLSH (Fire Retardant Low smoke and halogen evolution) |
- 1.7 Drum : Conforming to IS-10418(Wooden Drum)



Annexure-B

CONTROL CABLES

- 1.0 1100 V grade 70°C continuous rating under normal condition and 160°C under short circuit condition rating PVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded non-compacted and circular, high conductivity annealed plain copper, generally conforming to IS:8130.
- 1.2 Insulation : Extruded PVC compound conforming to type A of IS : 5831.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner Sheath : Extruded PVC compound conforming to type ST1 of IS:5831 for multi-core cables. Filler shall be of same material as of inner sheath i.e. ST1. Single core cables shall have no inner sheath.
- 1.5 Armour : Galvanised single round steel wire for twin and Multi-core cables.
- 1.6 Overall Sheath : Extruded PVC compound conforming to type ST1 of IS 5831 having improved fire performance category and type as stated below.
- | Category | Type |
|----------|--|
| C2 | FRLSH (Fire Retardant Low smoke and halogen evolution) |
- 1.7 Drum : Conforming to IS-10418 (Wooden Drum)





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
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Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION-III
SUB-SECTION-VI
TECHNICAL SPECIFICATION
UNINTERRUPTIBLE POWER SUPPLY (UPS)**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
Sub-section-VI
Uninterruptible Power Supply (UPS)**



VOLUME: II-B
SECTION-III
SUB-SECTION-VI

UNINTERRUPTIBLE POWER SUPPLY (UPS)
(FOR RATING BELOW 3KVA)

01. Type : Packaged Unit, Solid-state SCR/ power Transistor & Microprocessor controlled.
02. Duty : Continuous
03. Enclosure : Sheet steel, IP-42
04. Transformer : Ferro-resonant
05. Inverter : Solid state pulse width modulated
06. Inverter Capacity : To be decided by the bidder on load calculation. 25% extra capacity margin to be considered.
07. Control : Microprocessor based.
08. Battery : 220 Volt, Ni-Cd vented type, pocket plate high discharge battery of adequate capacity to meet the requirement of UPS, generally confirming to IS-10918
09. Total harmonic distortion : < 2%
10. Harmonic attenuation : 400%
11. Line regulation : Better than $\pm 5\%$
12. Load regulation : Better than $\pm 3\%$
13. Spike attenuation : 3000: 1
14. Power factor : Self-correcting > 0.95
15. Metering display : Frequency, Battery, input, output voltage & % load
16. Status display : ON, on battery, low battery, self-diagnostic malfunction alarm with SPDT potential free





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contacts rated at 230 VAC, 5A for each alarm.

17. Output
- a) Voltage : 240 V A.C, 50 Hz, 1-phase +/- 1.0%
 - b) Frequency : 50 Hz (+/- 0.5%)
 - c) Load Power factor : 0.8%
 - d) Wave form : Sinewave
18. Input
- a) Voltage : 180V to 270V A.C
 - b) Frequency : 45 to 60 Hz
 - c) Power Factor : 0.92
19. Battery back-up Capacity : 60 Minutes at full load
20. Charger : Built-in
21. Static switch : Built-in
22. Quantity : As required
23. Rating / Capacity : 125% of System powering capacity





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**NLC Tamil Nadu Power Ltd.
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Tuticorin, Tamil Nadu**

**VOLUME: II-B
SECTION-III
SUB-SECTION-VII
TECHNICAL SPECIFICATION
GROUNDING AND LIGHTNING PROTECTION**



Development Consultants Pvt. Ltd.

**Vol. II-B/Section-III
Sub-section-VII
Grounding & Lightning Protection**



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

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GROUNDING AND LIGHTNING PROTECTION

1.00.00 GROUNDING

- 1.01.00 Bidder shall provide a complete grounding system as needed for the RCC chimney. A ground mat, preferably circular type, of diameter at least five (5) meter more than the chimney foundation diameter shall be laid.
- 1.02.00 The grounding installation work shall conform to the requirements of the Indian Electricity Rules and Code of Practice for Earthing (IS: 3043) and relevant IEC as amended up-to-date.
- 1.03.00 The main ground mat shall be of bare MS round bar of at least 40 mm dia buried in earth at a min. depth of 1000 mm below finished grade level. Earth electrode of size 40 MM dia x 3 M length driven into the ground and connected to the ground grid conductor shall be provided, as required, to bring down the ground resistance.
- 1.04.00 Riser from the ground grid shall be at least 40 mm dia MS round bar and shall project 300 mm above grade / concrete floor level. All ground connections below grade shall be made by electric arc welding with low hydrogen content electrode. Above grade 50mmx6 mm galvanized mild steel (450 g/m² zinc coating min) flats shall be run as main ground conductors securely fixed at intervals not exceeding 1500 mm.
- One end of the galvanized mild steel flat shall be connected to the MS round bar riser by electric arc welding and the other end to the equipment by welding/ bolting, as necessary, subject to approval of the Consultant. All welded portion shall be painted with bituminous paints against possible corrosion.
- 1.05.00 The chimney ground mat shall be connected to the plant station ground mat by 40 mm dia MS round bar at two (2) points.
- 1.06.00 Ground grid resistance of the grounding system shall be less than one (1) ohm.
- 1.07.00 All the metallic parts such as platform, railing, pull boxes, junction boxes etc. shall be grounded using GI wire of suitable size to the nearest GS flat.





2.00.00 LIGHTNING PROTECTION

Lightning protection system shall conform to the requirements of IS:2309 & NFPA-780 as amended up-to-date. The work is subject to approval of the Owner/ Owner's Consultant.

2.01.00 Air Termination Rod

The chimney shall be provided with required no. of 40 mm dia., 4000mm long, GI air termination rod with standard GI dome and spikes on one end and 150mm x 6mm thick. MS plate welded to the other end. The complete unit shall be lead covered after fabrication. The lightning conductors shall be securely anchored with at least two (2) suitably spaced adequate size GI lead covered clamps near the top of the stack. Air termination rod shall be mechanically and electrically connected by the use of pressure type fittings to the cap ring and to a continuous circumferential band.

2.02.00 Circumferential Band

The circumferential band shall be 50mmx6mm GI lead covered flat fixed to the chimney at an interval not more than 1.0 m. This shall be mounted with suitable anchors at such a height as to be accessible from the top of platform for maintenance. The anchors shall be embedded in concrete wall of the stack. Further these circumferential bands round the chimney shall be interconnected by 50mm x 6mm thick GI lead covered flat.

2.03.00 Down Conductors

Required no. of 50mm x 6mm GI flat down conductors shall be provided. These shall be not more than 15m apart on the periphery of the stack at the ground level. The down conductor shall be connected to circumferential band at the top portion of the stack and to the grounding system at the bottom. These conductors shall be continuous as far as practicable. Intermediate breaks shall be electrically bonded to form continuous circuit from top to bottom. Lapping of down conductor by bolting is not acceptable.

These conductors shall be embedded in the outer surface of the concrete shell and shall come out of the shell below grade level. Conductors embedded in concrete shall have a minimum cover of 50 mm. Railings and steel in the platforms are to be grounded with 50mm x 6mm thick GI flat conductors which are in turn tied to the down conductors. Railings and steel in platforms, ladder, exposed steel works shall also be bonded to down conductors with 50mm x 6mm GI flat. Chimney ladder shall be electrically connected to the down conductors at top and bottom of the ladder. For this, the two (2) lower pairs of insert supporting the ladder shall be adequately connected to the earthing system and the top laid inserts shall be connected to the circumferential band connecting the down conductors. Each down conductor shall be connected to earthing electrode through test point. Conductor from the earthing electrode to a height of about 300 mm above ground level shall be 40 mm MS round bar and thereafter 50mm x 6mm GI flat run.





Each of the above earthing electrode shall be connected to the earthing mat at two points.

2.04.00 Testing Points

Each down conductor shall be provided with a testing point installed in GI box embedded on the outside surface of chimney at a height of 1.5m from the ground level. Testing point shall consist of 50mm x 6mm thick GI flat with hot dip galvanized bolts, nuts and washers. Incoming and outgoing portion of down conductor at the test point shall be galvanized.

02.05.00 Clamps, Anchors etc.

All connections, clamps, anchors etc. of the lightning protection system shall be made of GI fittings. All joints or any other form of electrical connections, unless otherwise specified, shall be clamped or bolted by high-pressure contact to form a connection of adequate current carrying capacity and mechanical strength. Soldered connections will not be permitted.

02.06.00 Vertical and Horizontal Reinforcing Bars

All vertical reinforcing bars at the top and the bottom portion of the chimney shall be electrically connected to the nearest horizontal reinforcing rods. At each place where vertical reinforcing rods shall be spliced, each of the spliced rods shall be electrically connected to at least one (1) horizontal reinforcing rod. The nearest vertical reinforcing bar shall be connected with down conductor at its upper and lower extremities and an additional connection shall be made at every 60meter interval by suitable clamping arrangement.

The ohmic resistances of the lightning protection system complete with air termination but without the earth connections, shall be a fraction of an ohm so as to permit heavy current flow easily.

2.07.00 Chimney staircase/ladder shall be electrically connected to the down conductors both at top and bottom. For this, the two lower pairs of inserts supporting the staircase shall be adequately grounded by connecting to the circumferential conductor connected to the down conductor. All intermediate breaks in the staircase should be electrically bonded to maintain continuity from top to bottom.

2.08.00 Temporary Lightning Protection

Temporary lightning protection system during construction to meet ICAO and DGCA requirements shall be provided by the bidder, complete with all the necessary fittings, hardware etc. required for installation. After top lift of the chimney shell has been completed, temporary air terminations, which may consist of reinforcing bars, should be installed at the top to serve as temporary protection until the lining and cap are completed and permanent air terminations, conductors etc. are complete.





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**VOLUME: II-B
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TECHNICAL SPECIFICATION
ERECTION**



Development Consultants Pvt. Ltd.

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ERECTION

1.00.00 SCOPE OF WORK

- 1.01.00 Scope of work shall cover complete and efficient erection, testing, commissioning and putting into successful commercial operation of all Outdoor and Indoor electrical equipment supplied under Chimney package.
- 1.02.00 Scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

- 2.01.00 Items to be supplied
- 2.01.01 Miscellaneous steel structures, tray supports, hangers & brackets for cable trays, mounting of local panels, push button stations etc. shall be supplied. Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary shall be supplied.
- 2.01.02 Insulating rubber mat of 1 meter width and conforming to IS 15652-2006 for laying in the front along the entire length of panels for the safety of operating personnel. The mat shall conform to the appropriate voltage class as per the said Standard.
- 2.01.03 All hardware, materials and miscellaneous items required to complete the erection job under this specification. All such hardware, materials and accessories shall be brand new ones of reputed make.

3.00.00 DESCRIPTION OF ITEM TO BE SUPPLIED

3.01.00 Junction Box

- 3.01.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanized, single door / double door, outdoor type with rain canopy, dust vermin and damp proof, generally conforming to IP: 55.
- 3.01.02 Junction boxes shall be complete with neoprene gasketed inspection cover, conduit knock out, terminal blocks and painted with one coat of red oxide primer and two finishing coats of pebble gray (RAL 7032) epoxy paint.





- 3.01.03 Junction boxes for outdoor use shall be weather proof IPW: 55 and shall be epoxy painted.
- 3.01.04 Junction boxes shall be of two types viz. one suitable for control wiring and the other with terminals for power cable terminations. Junction boxes for power cable terminations shall have minimum nine (9) nos. of terminals. Size of terminals shall be suitable to accommodate cables of sizes as required.
- 3.01.05 The junction boxes shall have the following indelible markings:
- i) Circuit nos. on top by white-stenciled paint at site.
 - ii) Circuit nos. with ferrules (inside) as per approved drawing.
 - iii) Danger sign in case of 415V circuit.
- 3.01.06 Junction boxes shall be provided with two nos. (2) earthing terminals complete with nuts and washers suitable for connection of 8 SWG GI wire.
- 3.02.00 **Cable Trays**
- 3.02.01 Cable trays shall be pre-fabricated ladder type sheet steel with hot dip galvanizing furnished in standard length of 2.5 meters and thickness of 2.0mm.
- 3.02.02 Standard cable tray width shall be 600 mm. However, trays with 450, 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 mm may be used and 600, 450, 300 mm perforated trays may be used depending on site requirement.
- 3.02.03 Cable trays shall be complete with all necessary hot dip galvanized sheet steel accessories such as coupler plates, ground continuity connections, nuts, bolts, washers, hangers/clamps etc. Also, horizontal/vertical bends, horizontal/vertical Tee, Reducers, Horizontal cross-pieces, protective covers shall be supplied along with straight runs in order to take care of cable tray alignments in different routes.
- 3.02.04 All fittings like horizontal/vertical elbow, horizontal crosspiece, reducer, horizontal tee etc. should be prefabricated.
- 3.02.05 Cable trays, fittings & accessories as well as elbows, reducers, tees, crosses etc. shall be fabricated out of 14 gauge (2 mm thick) hot rolled mild steel sheets.
- 3.02.06 The Contractor shall supply 14 gauge (2 mm thick) perforated type hot rolled mild steel sheet covers for vertical cable shafts upto a height of 2.5 meters from floor level. The perforated covers used for the vertical raceways may be of one or more pieces along the width of the raceway, depending on the width of the raceway and shall be bolted to the structural framework of the raceway.





- 3.02.07 The cable trays, fittings and accessories including all bolts, nuts, screws, washers etc. shall be hot dip galvanized after fabrication as per IS: 2629. Galvanizing shall be uniform, clear, smooth and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel will have to be re-galvanized at Contractor's cost.
- 3.02.08 The amount of zinc deposited shall not be less than 610 gms per square meter of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 80 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 80 microns.
- 3.02.09 The Contractor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are adequate to demonstrate that the equipment will comply with the requirement of this specification.
- 3.02.10 The tolerance on dimensions shall be in accordance with appropriate Indian Standards. The extent of the tests to be performed by the Contractor shall include but not be limited to the following:
- Deflection Test : A 2.5 meter straight section of each type of cable trays shall be simply supported at the two ends. A uniformly distributed load of 100 Kg per meter will be applied along the length of the tray. The maximum deflection at mid span shall not exceed 7 mm.
- 3.03.00 **Terminals**
- 3.03.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- 3.03.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.
- 3.04.00 **Cable Termination & Jointing Kits**
- 3.04.01 The Bidder shall supply cable termination and jointing kits in requisite quantity L.T. Power, Control Cables, Instrumentation Cables etc. along with all accessories & consumables required for making termination and joints complete. All the materials and components of the termination/joints shall be suitable and compatible with the type of cables for which the terminals/joints are intended.





3.04.02 The straight through joints L.T. cables shall be of Tapex/Paracast/Parawrap type. Cable joint or end terminations on Electrical equipment shall be suitable for Indoor & Outdoor use, as the case may be.

3.04.03 Glands and lugs required for termination of L.T. and instrumentation cables shall be supplied by the Contractor in required quantity.

3.05.00 **Cable Glands**

Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer etc. Cable glands shall match with the sizes of different LT/Control cables.

3.06.00 **Cable Lugs**

All cable lugs shall be Cd plated copper. Cable lugs shall be suitable for termination of different cross-sections of L.T./Control/Instrumentation cables and shall be of following types :

- i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.
- ii) Copper tubular terminal end for solderless crimping to copper conductors. Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/ instrumentation cables shall be PVC insulated/sleeved type.
- iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

3.07.00 **Conduits & Accessories**

3.07.01 Conduits shall be of rigid steel, hot-dip galvanized, furnished in standard length of 5 meters, threaded at both ends.

3.07.02 Conduits diameter upto and including 25mm size shall be of 1.6 mm and conduits above 25 mm diameter shall be of 2.0 mm. Minimum diameter of conduits shall be 20 mm.

3.07.03 Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.

3.07.04 The Contractor shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes etc. complete with accessories such as tees, bends, adapters, locknuts, pull boxes, conduit plugs, caps etc as required for the cabling work.





- 3.07.05 Steel conduits with interior coating of silicon epoxy ester for ease of wire/cable pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanized. These shall be supplied in standard length of 51V! with minimum wall thickness as specified in IS: 9537. In chemical handling areas, Battery Room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.
- 3.07.06 For sizes above 63 mm mild steel pipes with necessary fittings & accessories shall be provided and installed by the Contractor. Pipes shall be manufactured by electric welding process. These pipes shall be of heavy-duty class as per IS: 1239 and shall have ISI mark. Pipes shall be supplied in lengths of approximately 5 meters. Pipes, fittings & accessories shall be hot dip galvanized both on inside and outside.
- 3.07.07 Flexible conduits shall comply with IS: 3480. They shall be made with bright, cold-rolled, annealed and electro-galvanized mild steel strips. Flexible conduits shall be used between embedded conduits / pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.
- 3.07.08 Rigid PVC conduits conforming to IS: 4985 shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones generally, the PVC pipes with special Bell MOUTHING shall be of 110 mm, 160 mm & 200 mm outside diameter and shall be suitable for working pressure, of 6 kg/sq. cm. The length of each pipe shall be 5 to 6 meters. Necessary fittings & accessories as may be required for the installation shall also be provided
- 3.08.00 **Local Control Boards/Panels**
- a) Local Control Boards may consist of a number of vertical panels mounted side-by-side, in which case, they shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close-fitting, and unobtrusive.
 - b) The control boards/panels shall be totally enclosed type, conforming to degree of protection IP-54 or better.
 - c) Generally, the local control boards/panels shall be free-standing, floor-mounted, dead-front assemblies. In some cases, however, wall-mounted type control boards/panels may also be accepted.
 - d) Floor-mounted control boards/panels shall be assembled on channel/ angle base plates with anti-vibration mountings and stainless steel kick-plates.
 - e) Control boards/panels shall be of folded sheet steel construction, minimum 2 mm. thick, and free from all surface defects.





The boards/panels shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.

- f) All floor-mounted panels shall have rear door.
- g) Doors shall have concealed type hinges and padlocking arrangement. Doors shall be grounded by flexible copper braid.
- h) All doors and removable covers shall be provided with neoprene rubber gaskets all round and latches sufficiently strong to hold them in alignment when closed.
- i) Working height of the panels shall be limited between 550 mm and 1800 mm above floor level.

3.09.00

Local Push Button Stations

- a) L.P.B. Stations shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketed construction, suitable for outdoor use without canopy, and conforming to degree of protection IP-55 or better.
- b) L.P.B. Stations shall be suitable for column/structure/wall mounting and shall be complete with push-buttons, terminal blocks, anodised aluminum inscription plate, two (2) nos. earthing terminals, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing terminals shall be suitable for connection to one (1) no. 8 SWG G.I. wire.
- c) L.P.B. Stations shall be of the following basic type and equipped with:
 - Type-A : One (1) START push-button and one (1) STOP push-button.
 - Type-B : One (1) OPEN push-button, one(1) CLOSE push-button, and One (1) STOP push-button.
 - Type-C : Flame proof type as per IS-2148. one (1) START push-button and one(1) STOP push-button.
 - Type-D : One (1) STOP Lock-out switch.

Any other type of L.P.B. Station, if required, shall be subject to approval of the Purchaser .

- d) OPEN, CLOSE, and START push-buttons shall be spring return to normal type. STOP push-buttons shall have mushroom head actuator with press-to-latch and key-to-release feature.





- e) OPEN/START push buttons shall be GREEN, STOP push buttons shall be RED, and CLOSE buttons may be YELLOW.
- f) All push-buttons shall have a minimum of two (2) Normally-Open and two (2) Normally-Closed electrically separate contacts, rated minimum 10 A at operating voltage.
- g) Wiring shall be done by 1/C - 2.5 sq.mm. 1100V grade, PVC insulated, stranded copper conductor, cable. Each wire shall be identified at both ends by ferrules with wire designation.
- h) Terminals shall have provision for connecting at least two (2) nos. 2.5 sq.mm. copper cable and shall be rated for carrying continuously minimum 10 A at 240V A.C. and 2 A at 220V D.C

4.00.00 SCOPE OF SERVICES

The work includes but not limited to the followings:

- 4.01.00 Furnishing of all erection tools and tackle, implements, supplies, consumables and hardware for timely and efficient execution of the erection work.
- 4.02.00 Transport vehicles necessary for efficient transportation of equipment from stores to site of erection and excess materials back to stores.
- 4.03.00 Entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.
- 4.04.00 Erection work of equipment shall be carried out in a neat and efficient way so as not to impair their normal functioning in any way.
- 4.05.00 All erection work under this specification shall be carried out strictly in accordance with the approved drawings.
- 4.06.00 **Methods and Workmanship**
 - 4.06.01 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.
 - 4.06.02 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.
- 4.07.00 **Consumables and Hardware**
 - 4.07.01 The Contractor shall furnish all erection materials, hardware and consumables required for the completion of the installation.
 - 4.07.02 The materials shall include but not be limited to the following:





**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- a) Consumables : Welding rods & gas, oil and grease, cleaning fluids, Paints, electrical tape, soldering materials etc.
- b) Hardware : Bolts, nuts, washers, screws, brackets, supports, Clamps, hangers, saddles, cleats, sills, shims etc.
- c) Materials : Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.

4.07.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.

4.08.00 **Cleaning up of Work Site**

4.08.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

4.08.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.



**CABLING
NOTES & DETAILS**



DWG. NO. 18A09-DWG-E-0400

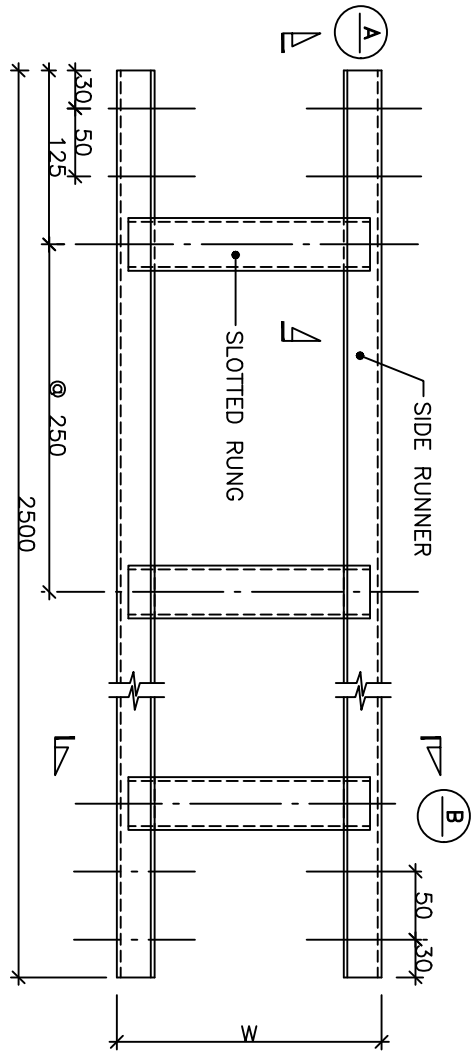
FOR TENDER PURPOSE ONLY

NOTES:-

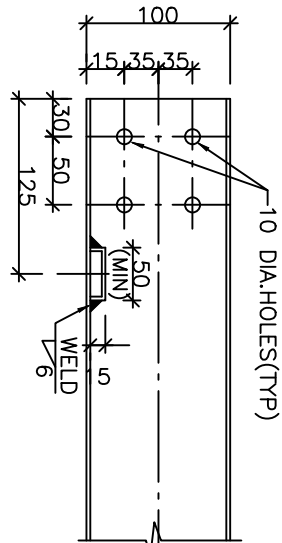
1. THE CABLING WORK SHALL BE DONE IN ACCORDANCE TO THE STIPULATION OF THE SPECIFICATION.
2. THE CABLING WORK SHALL COMPRISE OF THE FOLLOWING AND/OR AS STIPULATED IN THE SPECIFICATION:-
 - ON TRAY : LAYING, DRESSING, CLAMPING OF CABLES ON TRAY, FIXING OF CABLE TAG INCLUDING THE SUPPLY OF CABLE CLAMPS, CABLE TAGS AND FIXING HARDWARES.
 - BURIED : EXCAVATION OF EARTH, FILLING BY SAND, PROVIDING BRICK PARTITION, LAYING AND DRESSING OF CABLE, FIXING OF CABLE TAG, SAND COVERING FOLLOWED BY FIXING OF PRECAST COVER, BACKFILLING BY GOOD EARTH FOLLOWED BY COARSE EARTH INCLUDING THE SUPPLY OF CABLE TAG, SAND, BRICK, PRECAST COVER.
 - SHALLOW TRENCH : LAYING, DRESSING, FIXING OF CABLE TAG, FILLING WITH SAND AND FIXING OF BRICK COLUMN INCLUDING SUPPLY OF SAND, BRICK AND CABLE TAG.
 - DUCT BANK : PULLING OF CABLE AND FIXING OF CABLE TAG.
3. TERMINATION WORK SHALL BE DONE IN ACCORDANCE TO THE STIPULATION OF THE SPECIFICATION INCLUDING SUPPLY OF LUGS, GLANDS FOR CONTROL CABLE.
4. ARMOUR/SCREEN OF MULTI CORE CABLES SHALL BE GROUNDED AT BOTH END.
5. ARMOUR/SCREEN, IF ANY, OF SINGLE CORE CABLE SHALL BE GROUNDED ONLY AT SOURCE END.
6. ALL WALL/FLOOR OPENINGS FOR CABLE ENTRY SHALL BE SUITABLY SEALED WITH FIRE RATING OF 90 MINUTE AFTER CABLE ERECTION.
7. CLAMPING OF ADJACENT CABLES ON THE SAME RACK SHALL BE STAGGERED TO AVOID FOULING OF THE CLAMPING BOLTS.

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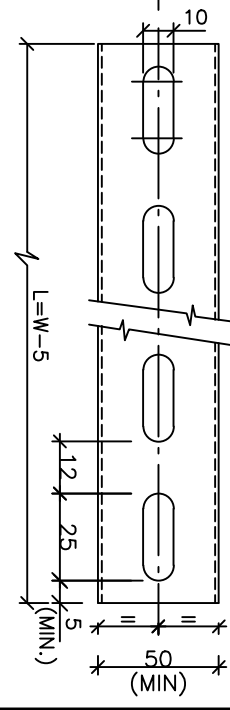
DS	SM	BG	-	12.02.19	 NLC TAMILNADU POWER LIMITED	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	JOB NO. 18A09	SCALE : NTS			
APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN	DWG. NO. 18A09-DWG-E-0400 SHT. 01 OF 28		REV.			



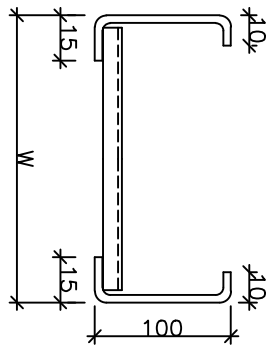
LADDER TYPE CABLE TRAY



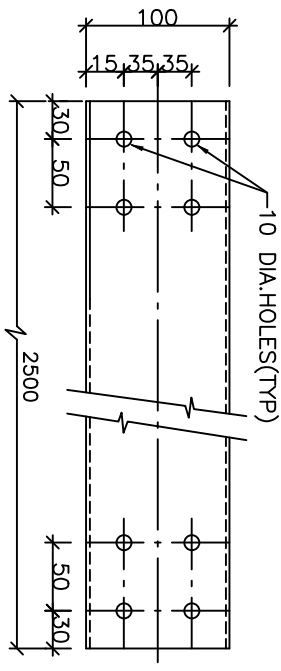
SEC -- (A)



SLOTTED RUNG



SEC -- (B)



SIDE RUNNER



MATERIAL : M.S. SHEET 14 SWG.(2mm.THK.)
FINISH : HOT DIP GALVANISED

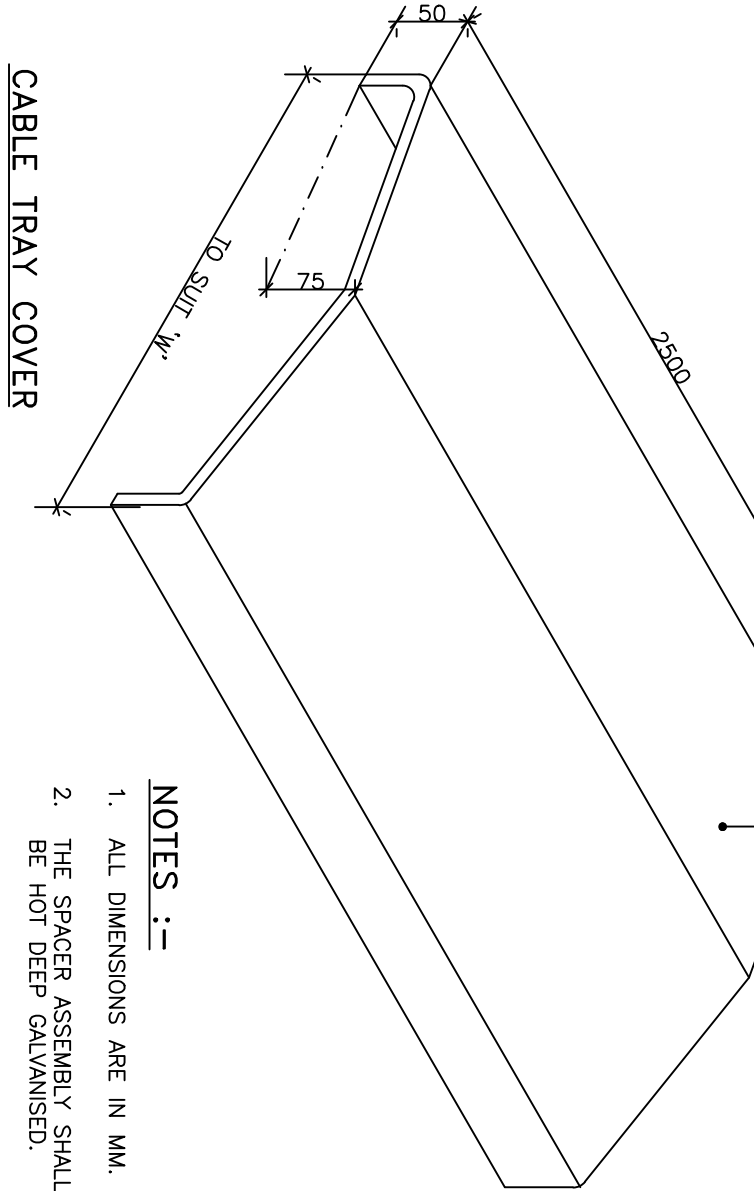
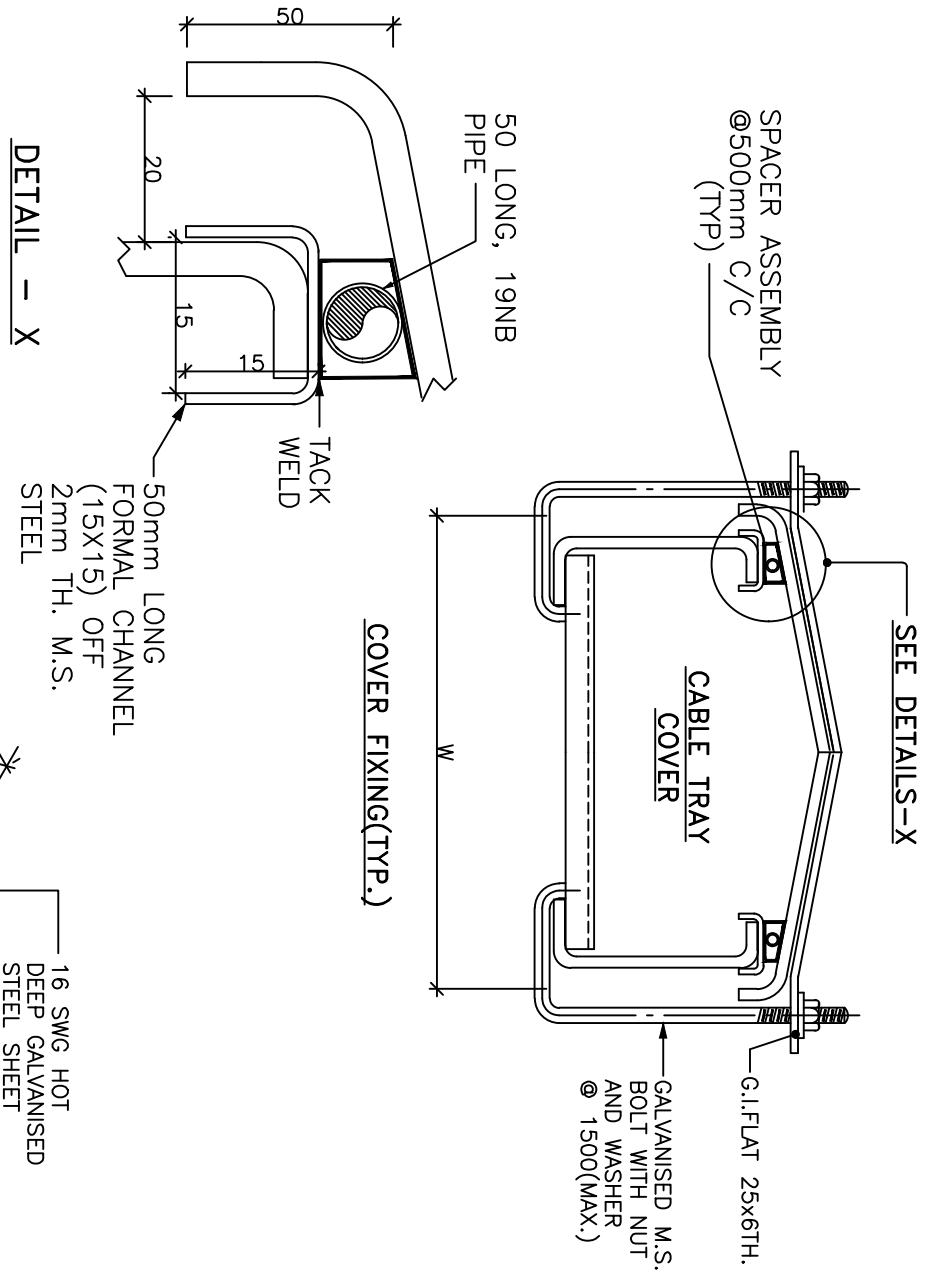
W	300	450	600
L	295	445	595

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

			 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
CABLING NOTES & DETAILS						
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09
APPVD.	REVWD.	CHKD.	REV.	DATE		SCALE : NTS
						DWG. NO. 18A09-DWG-E-0400
						SHT. 02 OF 28
						REV.



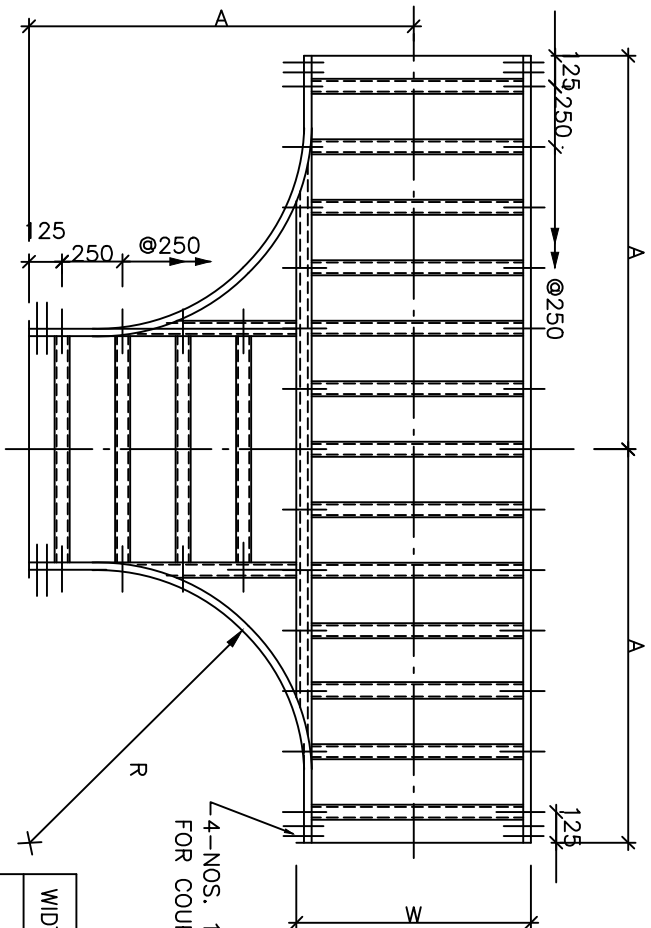
CABLE TRAY COVER

FOR TENDER PURPOSE ONLY

NOTES :-

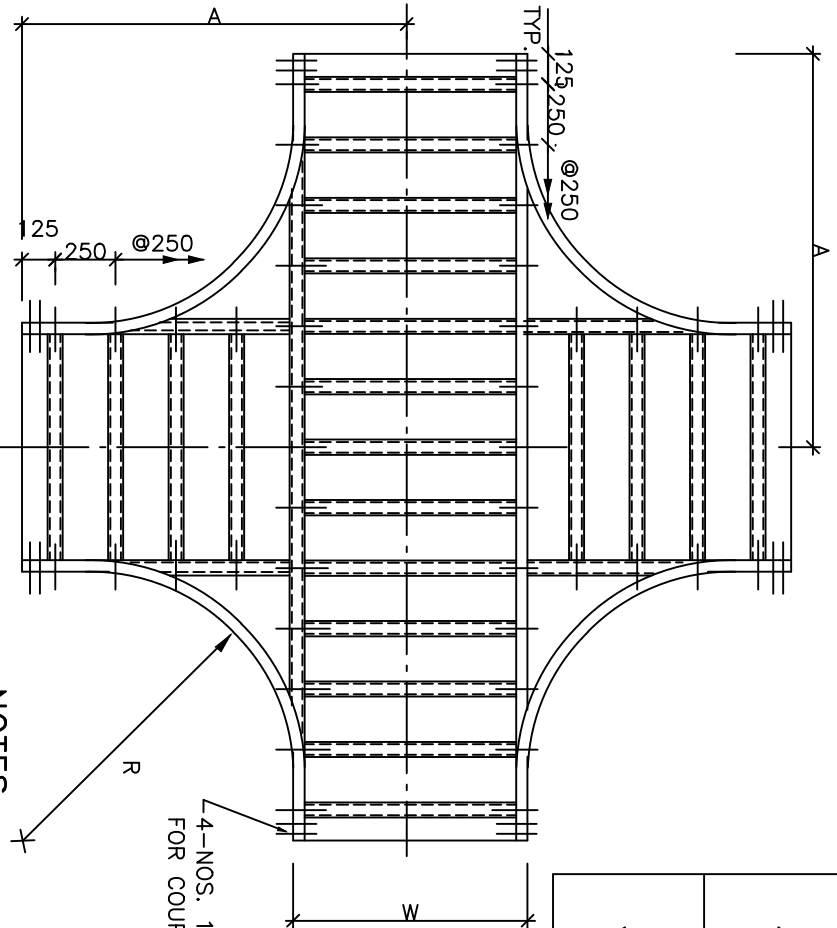
1. ALL DIMENSIONS ARE IN MM.
2. THE SPACER ASSEMBLY SHALL BE HOT DEEP GALVANISED.

		CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
 NLC TAMILNADU POWER LIMITED 2X500MW THERMAL POWER PLANT AT TUTICORIN					
		JOB NO.	18A09	SCALE :	NTS
		DWG. NO.	18A09-DWG-E-0400	SHT.	04 OF 28
				REV.	-



HORIZONTAL TEE PLAN

WIDTH (W)	RADIUS (R)	A
600	1050	1475
	600	1025
	450	875
450	300	725
	1050	1400
	600	950
300	450	800
	300	650
	1050	1325
	600	875
	450	725
	300	575

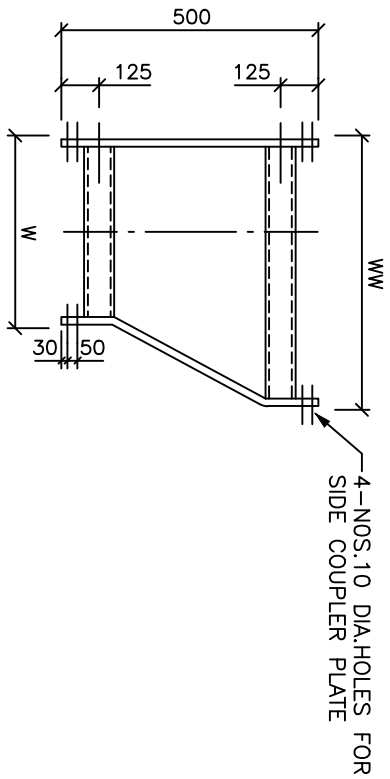


HORIZONTAL CROSS PLAN

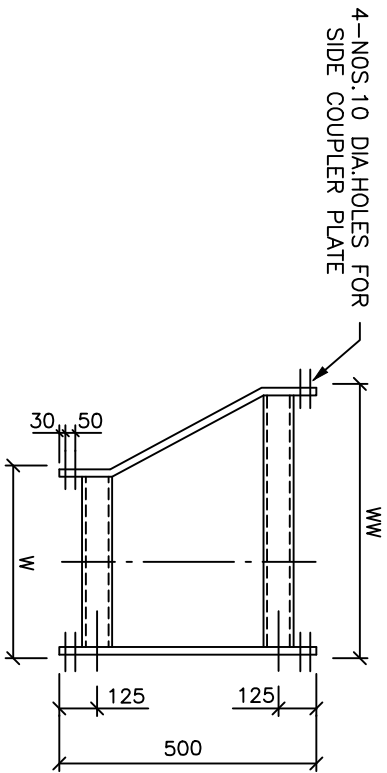
FOR TENDER PURPOSE ONLY

- NOTES :-**
1. ALL DIMENSIONS ARE IN MM.
 2. FOR MULTITIER CABLE TRAY, THE BENDING RADIUS AT THE BENDS SHALL BE SAME FOR ALL TRAYS AND THIS RADIUS SHALL BE AS PER THE RECOMMENDED BENDING RADIUS OF LARGEST CABLE IN THE ROUTE.

<p style="text-align: center;">CABLING NOTES & DETAILS</p> <p style="text-align: center;">NLC TAMILNADU POWER LIMITED</p>				<p style="text-align: center;">DEVELOPMENT CONSULTANTS PVT. LTD.</p> <p style="text-align: center;">CONSULTING ENGINEERS</p>	
DS	SM	BC	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
<p style="text-align: center;">2X500MW THERMAL POWER PLANT AT TUTICORIN</p>			<p style="text-align: center;">JOB NO. 18A09 SCALE : NTS</p> <p style="text-align: center;">DWG. NO. 18A09-DWG-E-0400 SH. 05 OF 28 REV.</p>		



PLAN
LEFT HAND REDUCER





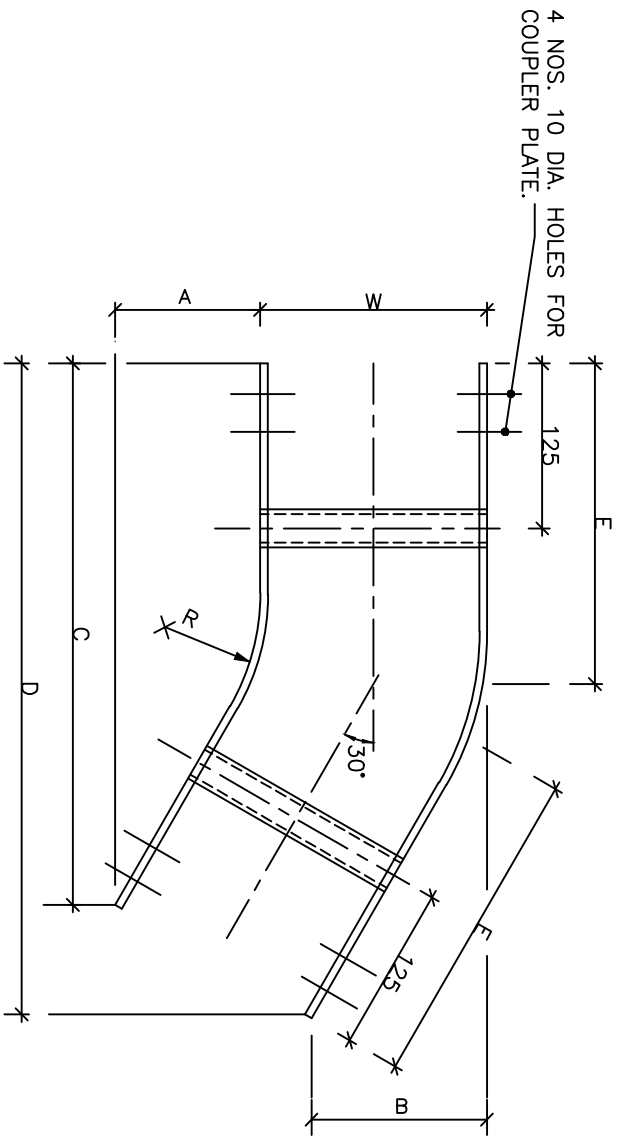
PLAN
RIGHT HAND REDUCER

WIDTH	WW	600	600	450
	W	450	300	300

NOTE :-
1. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

				 CABLING NOTES & DETAILS NILC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE					DWG. NO. 18A09-DWG-E-0400 SH. 06 OF 28	REV.





PLAN
30° HORIZONTAL ELBOW

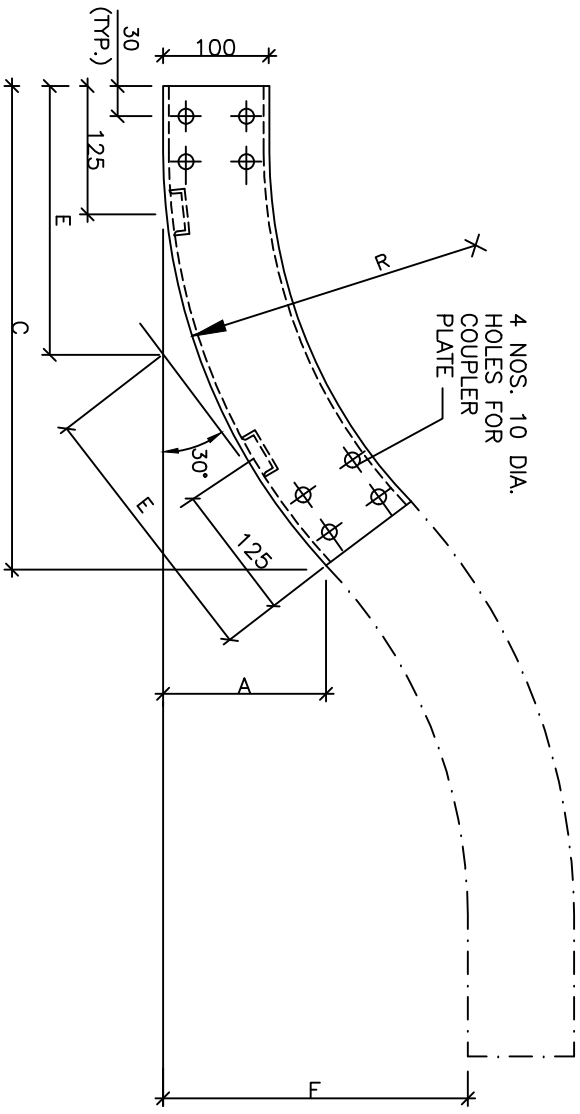
WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	205	285	755	1055	485
	600	145	225	530	830	365
	450	125	205	455	755	325
450	300	105	185	380	680	285
	1050	205	265	755	980	465
	600	145	205	530	755	345
300	450	125	185	455	680	305
	300	105	165	380	605	265
	1050	205	245	755	905	445
300	600	145	185	530	680	325
	450	125	165	455	605	285
	300	105	145	380	530	245

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

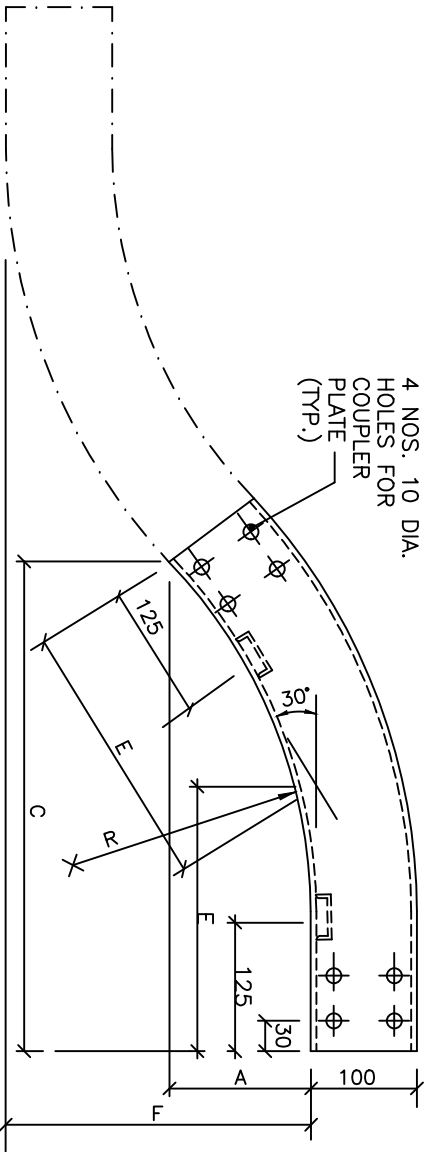
FOR TENDER PURPOSE ONLY

				 CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0400	
DS	SM	BG	-	12.02.19	SCALE :	NTS	REV.
APPVD.	REVWD.	CHKD.	REV.	DATE			



30° VERTICAL ELBOW (INSIDE)



WIDTH(W)	RADIUS(R)	A	C	E	F
600	1050	205	760	410	410
450	600	145	535	290	290
&	450	125	460	250	250
300	300	105	385	210	210

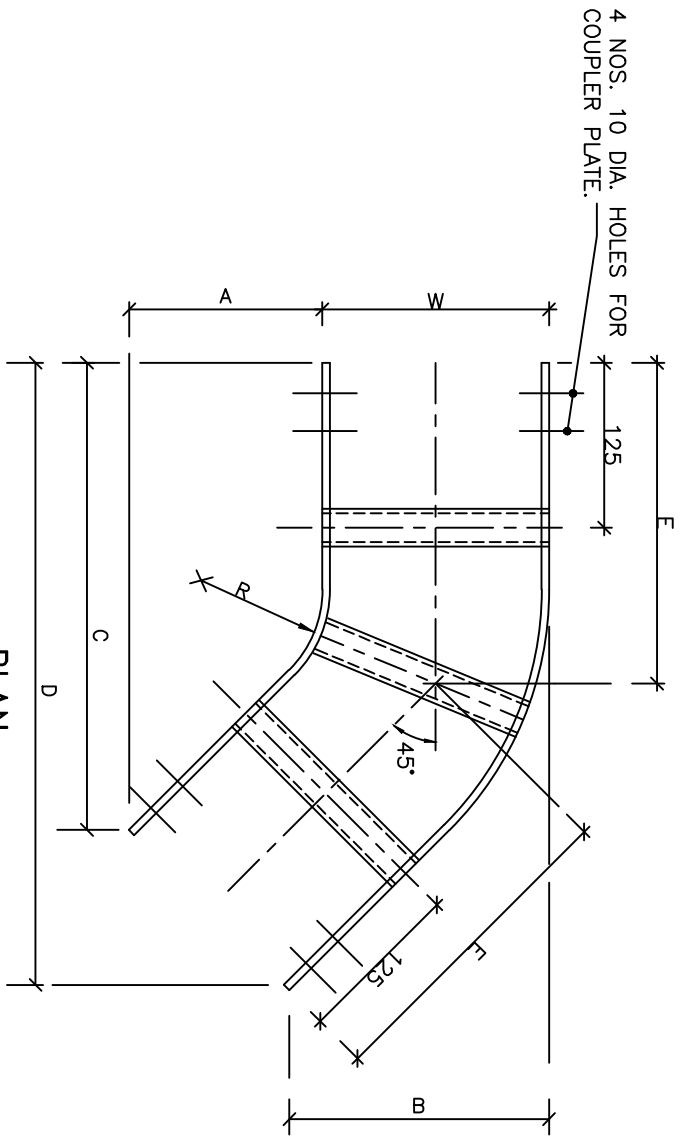


30° VERTICAL ELBOW (OUTSIDE)

NOTE :-
1. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

DS		SM		BG		-		12.02.19		 NLC TAMILNADU POWER LIMITED CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
APPVD.	REVWD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN							JOB NO. 18A09	SCALE : NTS
												DWG. NO. 18A09-DWG-E-0400	REV.
												SH. 08 OF 28	





45° HORIZONTAL ELBOW

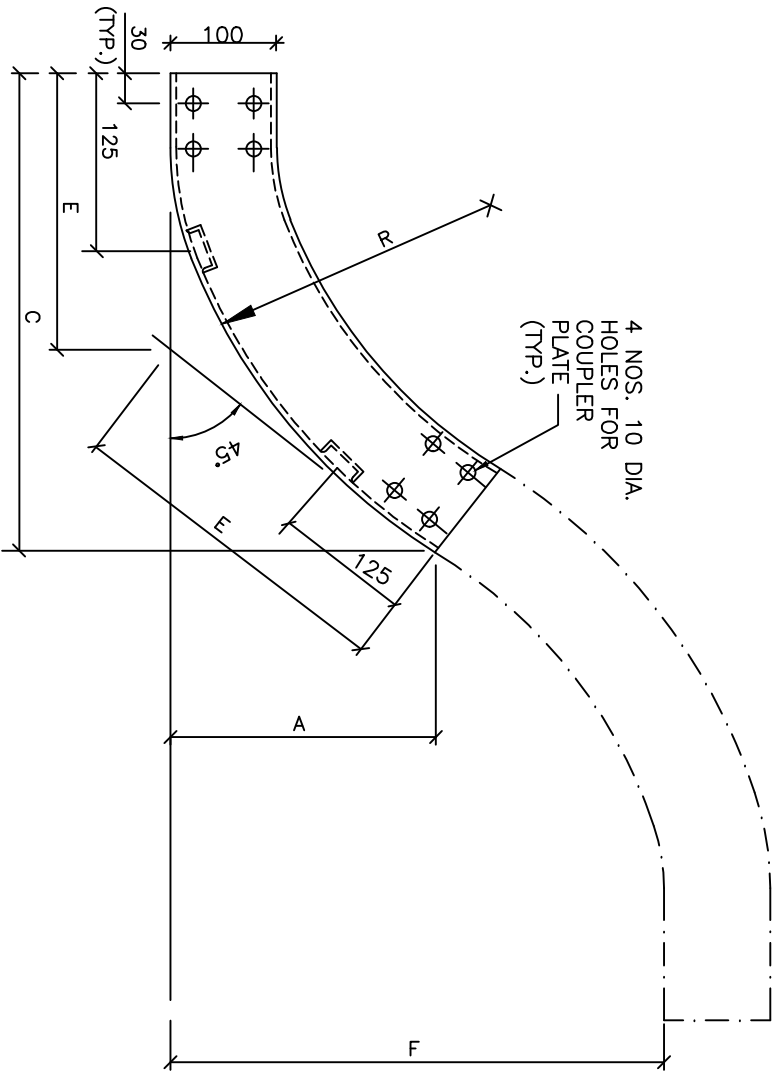
WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	395	570	955	1380	685
	600	265	440	640	1065	535
	450	220	395	530	955	470
450	300	175	350	425	850	410
	1050	395	530	955	1275	690
	600	265	395	640	955	500
300	450	220	350	530	850	440
	300	175	310	425	745	390
	1050	395	485	955	1165	655
	600	265	350	640	850	470
	450	220	310	530	745	410
	300	175	265	425	635	345

NOTE :-

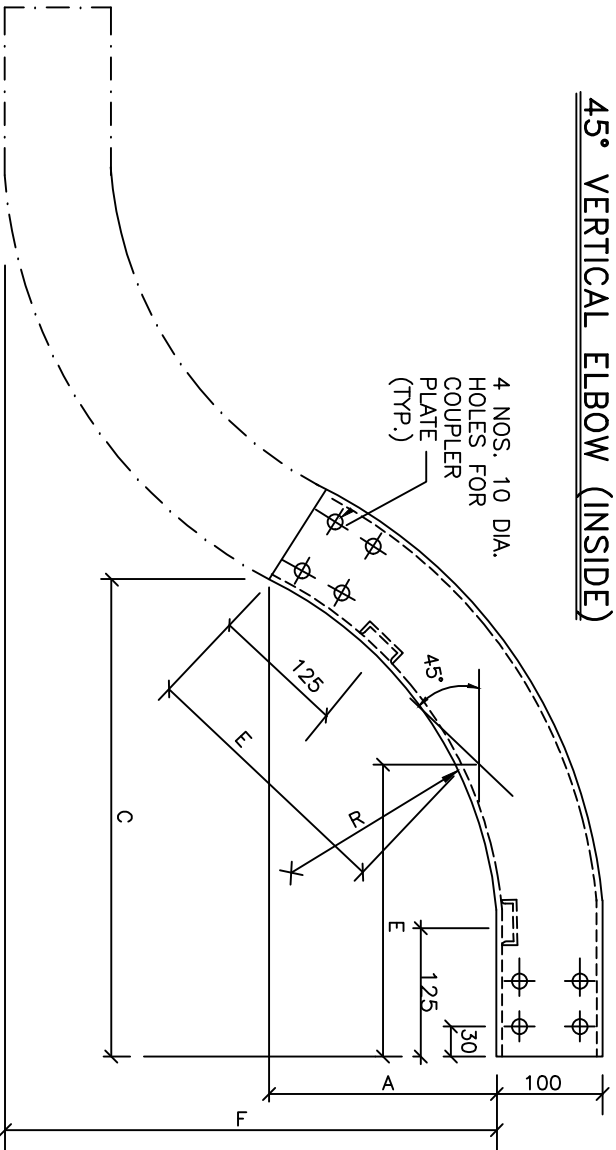
1. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
CABLING NOTES & DETAILS								
2X500MW THERMAL POWER PLANT AT TUTICORIN								
DS	SM	BG	-	12.02.19	JOB NO.	18A09	SCALE :	NTS
APPVD.	REVWD.	CHKD.	REV.	DATE	DWG. NO.	18A09-DWG-E-0400	SH. 09 OF 28	REV.



45° VERTICAL ELBOW (INSIDE)



45° VERTICAL ELBOW (OUTSIDE)

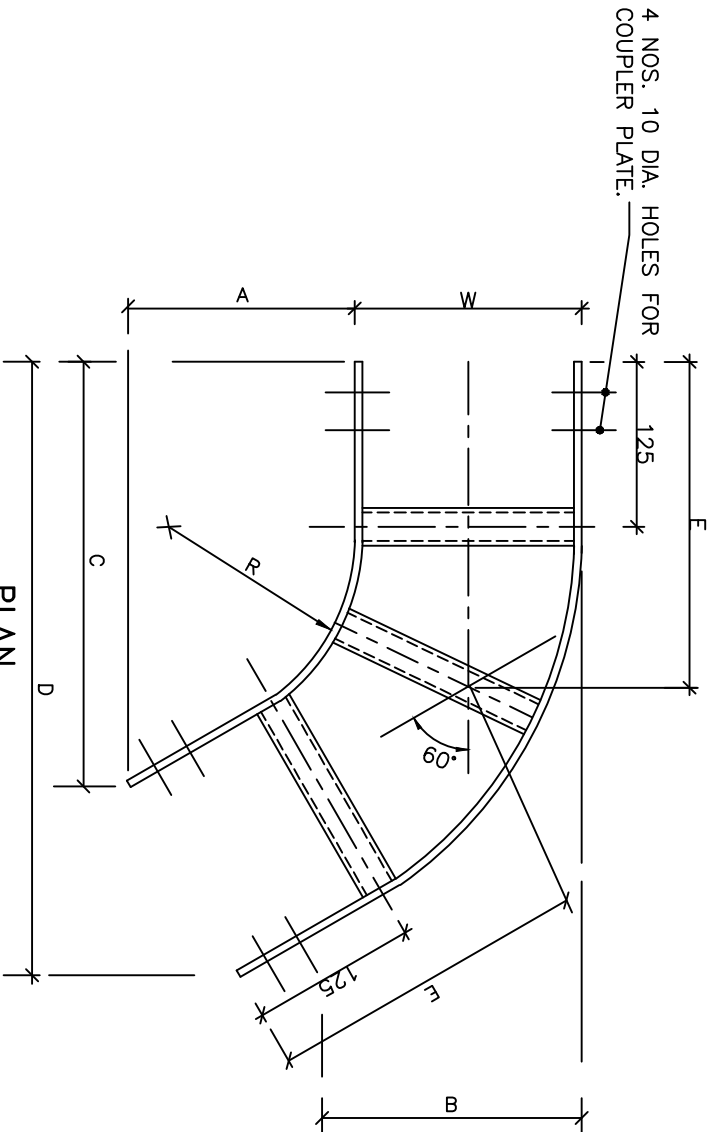
WIDTH(W)	RADIUS(R)	A	C	E	F
600	1050	395	955	560	790
450	600	265	640	375	530
&	450	220	530	310	440
300		300	175	425	250

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

<p>CABLING NOTES & DETAILS</p> <p>NILC TAMILNADU POWER LIMITED</p>			<p>DEVELOPMENT CONSULTANTS PVT. LTD.</p> <p>CONSULTING ENGINEERS</p>		
DS	SM	BG	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
<p>2X500MW THERMAL POWER PLANT AT TUTICORIN</p>			<p>JOB NO. 18A09</p> <p>DWG. NO. 18A09-DWG-E-0400</p> <p>SCALE : NTS</p>		
			<p>SHT. 10 OF 28</p>		





60° HORIZONTAL ELBOW

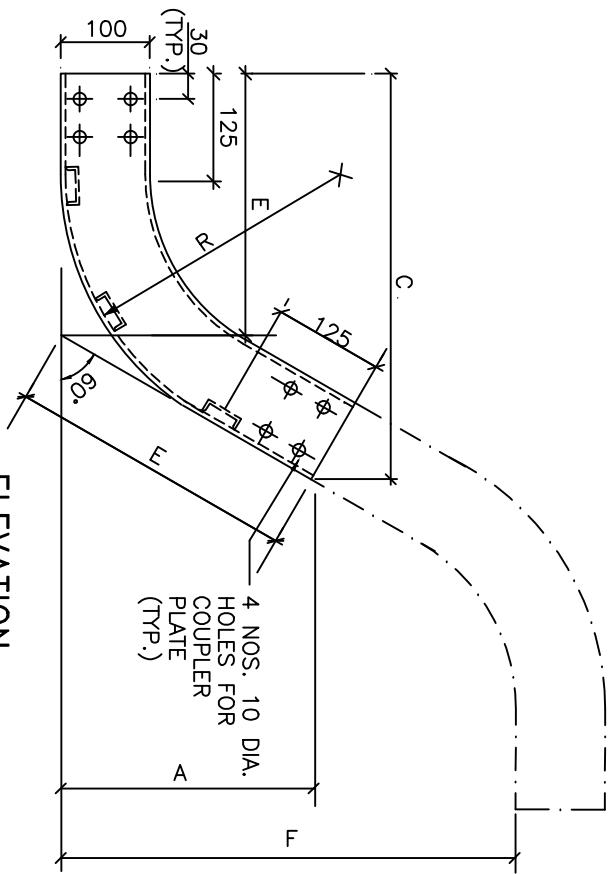
WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	635	935	1095	1615	905
	600	410	710	705	1225	645
	450	335	635	575	1095	560
450	300	250	550	450	965	470
	1050	635	860	1095	1485	860
	600	410	635	705	1095	600
300	450	335	550	575	965	515
	300	250	485	450	835	425
	1050	635	785	1095	1355	815

NOTE :-

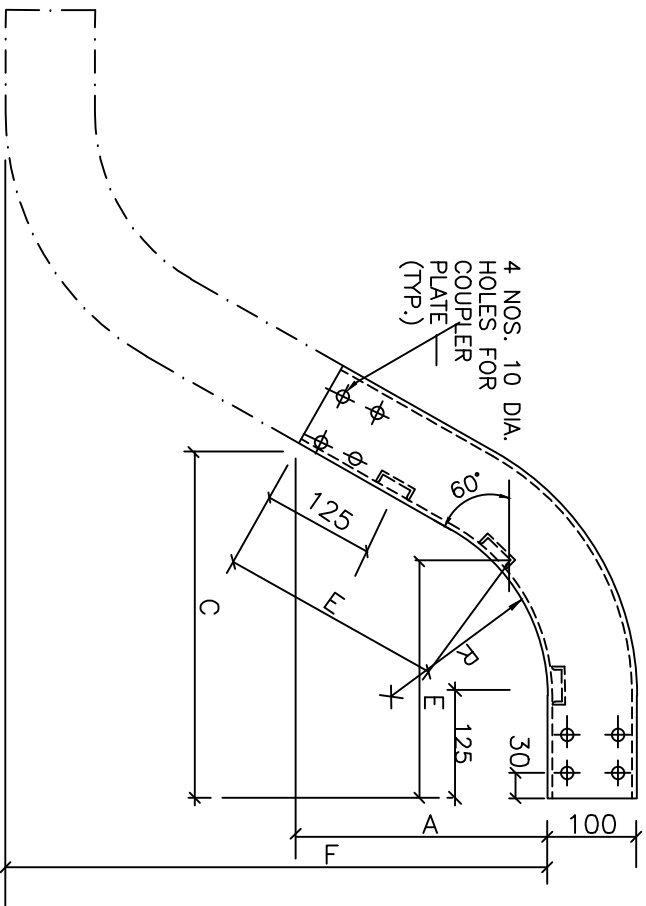
1. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

			 CABLING NOTES & DETAILS			 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
			NLC TAMILNADU POWER LIMITED			JOB NO. 18A09		
			2X500MW THERMAL POWER PLANT AT TUTICORIN			DWG. NO. 18A09-DWG-E-0400		
DS	SM	BG	-	12.02.19				SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE				REV.



60° VERTICAL ELBOW (INSIDE)
ELEVATION





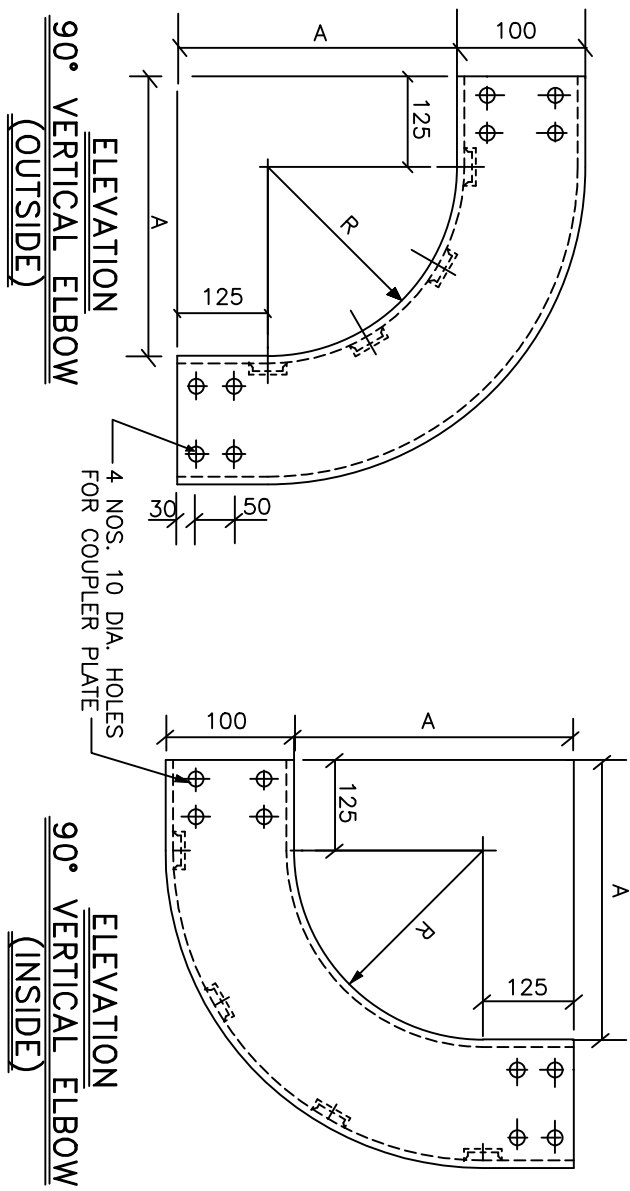
60° VERTICAL ELBOW (OUTSIDE)
ELEVATION

WIDTH(W)	RADIUS(R)	A	C	E	F
600	1050	635	1095	730	1270
450	600	410	705	470	820
&	450	335	575	385	670
300	300	260	450	300	520

NOTE :-
1. ALL DIMENSIONS ARE IN MM.

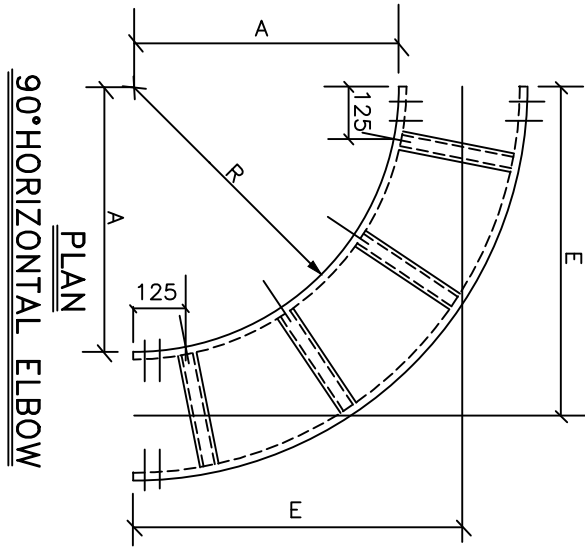
FOR TENDER PURPOSE ONLY

				 CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTTICORIN		JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE			DWG. NO. 18A09-DWG-E-0400	REV.
							SHT. 12 OF 28	



VERTICAL ELBOW		
WIDTH (W)	RADIUS (R)	A
600	1050	1175
450 & 300	600	725
	450	575
	300	425

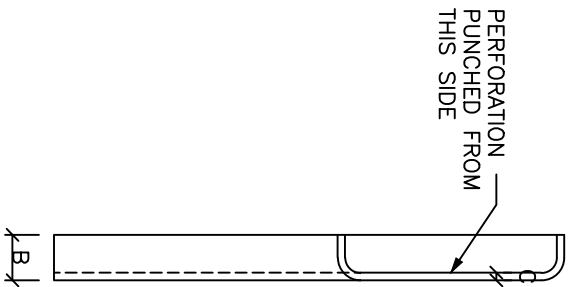
HORIZONTAL ELBOW			
WIDTH (W)	RADIUS (R)	A	E
600	1050	1175	1475
	600	725	1025
	450	575	875
450	300	425	725
	1050	1175	1400
	600	725	950
300	450	575	800
	300	425	650
	1050	1175	1325
	600	725	875
	450	575	725
	300	425	575



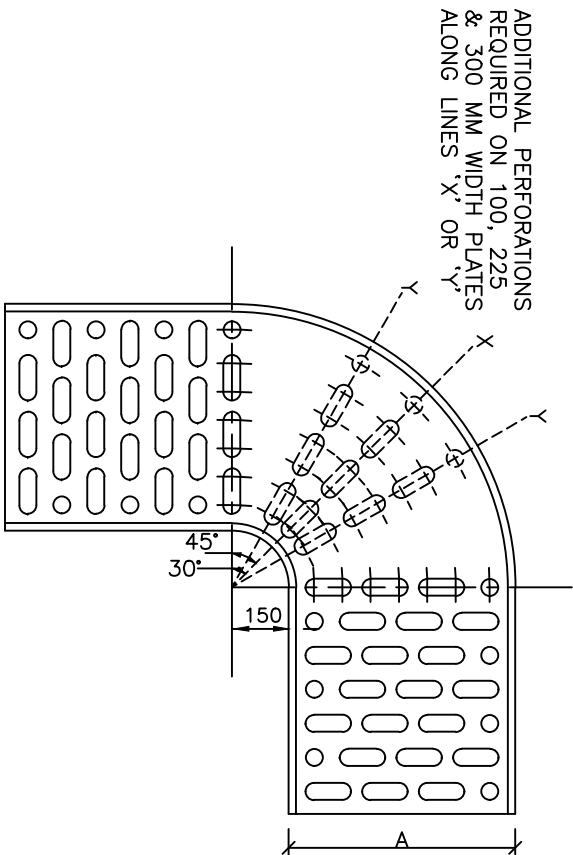
- NOTES :-**
1. ALL DIMENSIONS ARE IN MM.
 2. FOR MULTITIER CABLE TRAY, THE BENDING RADIUS AT THE BENDS SHALL BE SAME FOR ALL TRAYS AND THIS RADIUS SHALL BE AS PER THE RECOMMENDED BENDING RADIUS OF LARGEST CABLE IN THE ROUTE

FOR TENDER PURPOSE ONLY

CABLING NOTES & DETAILS				NLC TAMILNADU POWER LIMITED	
DEVELOPMENT CONSULTANTS PVT. LTD.				CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
2X500MW THERMAL POWER PLANT AT TUTICORIN					
JOB NO. 18A09			SCALE : NTS		
DWG. NO. 18A09-DWG-E-0400			REV. .		
SHT. 13 OF 28					

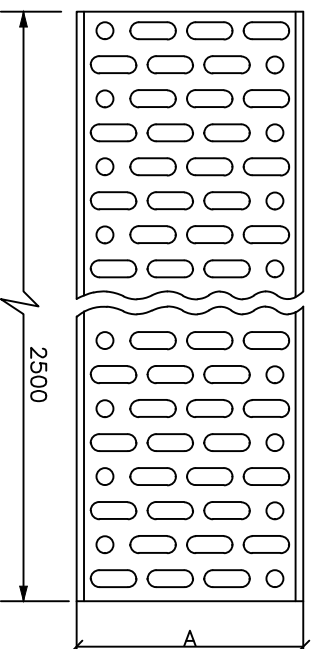


END ELEVATION

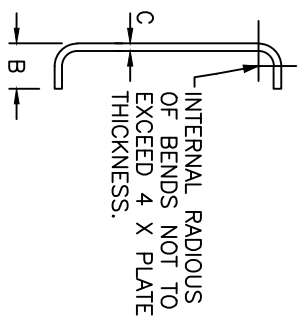


PLAN

DIMENSIONS IN MM	
WIDTH-A	DEPTH-B
100	50
150/225	50
300	50



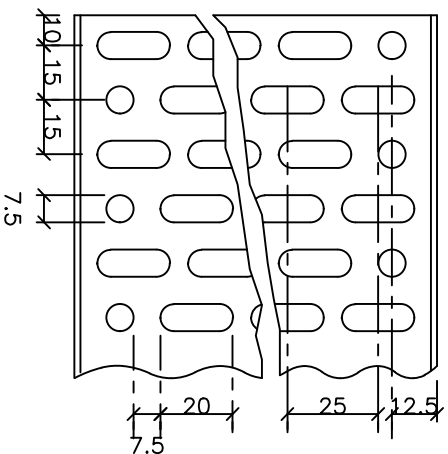
90° HORIZONTAL ELBOW



END ELEVATION

PLAN

STRAIGHT LENGTH





DETAILS OF PERFORATION

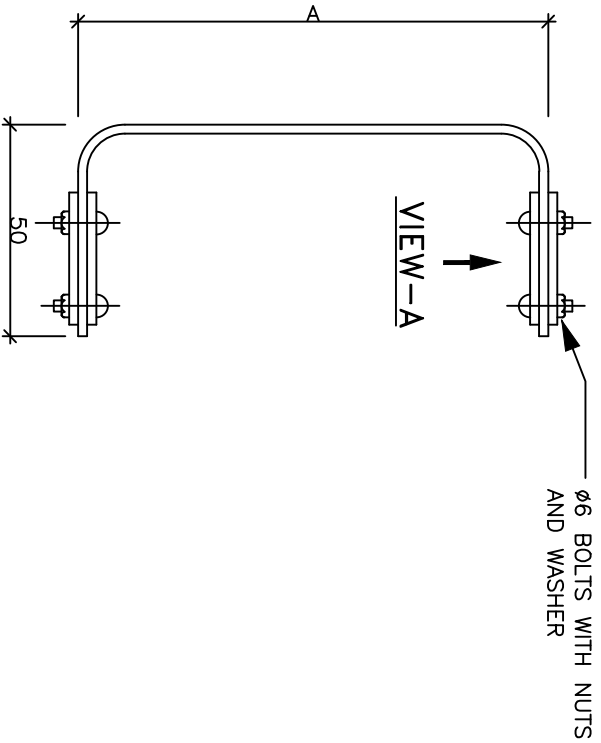
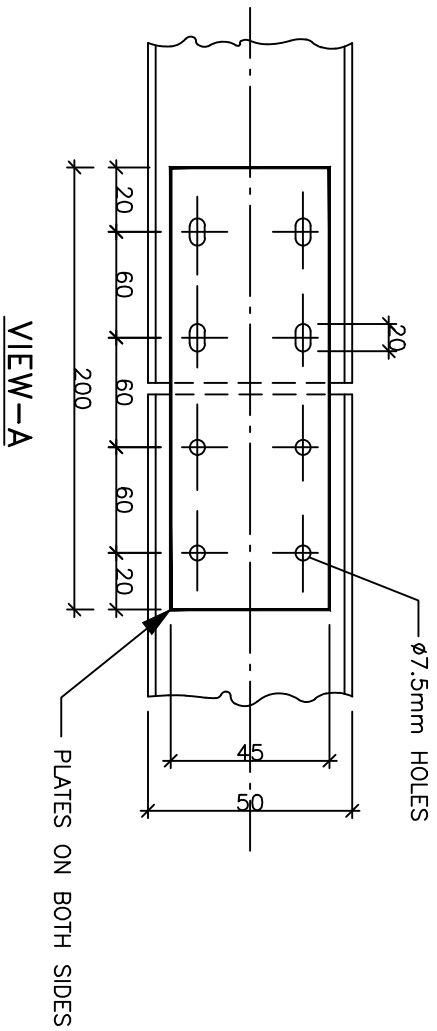
NOTES :

1. ALL CUTTING & FORMING OPERATIONS TO BE COMPLETED PRIOR TO GALVANIZING.
2. FINISHED TRAYS TO BE FREE FROM BURRS AND SHARP EDGES.
3. ALL DIMENSIONS ARE IN MM.

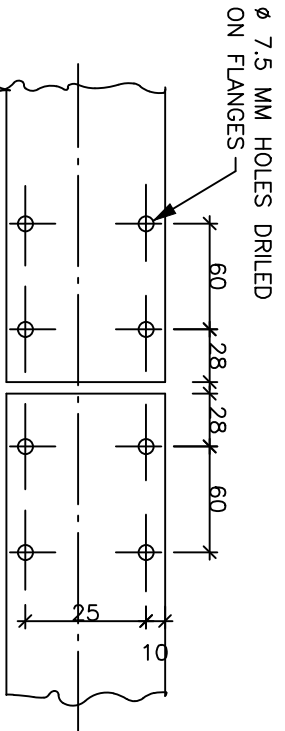
PERFORATED TYPE CABLE TRAY

FOR TENDER PURPOSE ONLY

 NLC TAMILNADU POWER LIMITED				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
CABLING NOTES & DETAILS							
DS	SM	BG	-	12.02.19	JOB NO. 18A09		SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE	DWG. NO. 18A09-DWG-E-0400		REV.
					2X500MW THERMAL POWER PLANT AT TUTICORIN		
					SH. 14 OF 28		



END ELEVATION





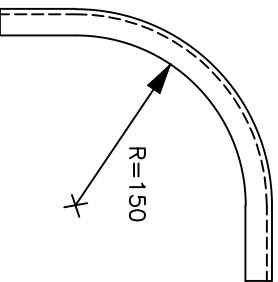
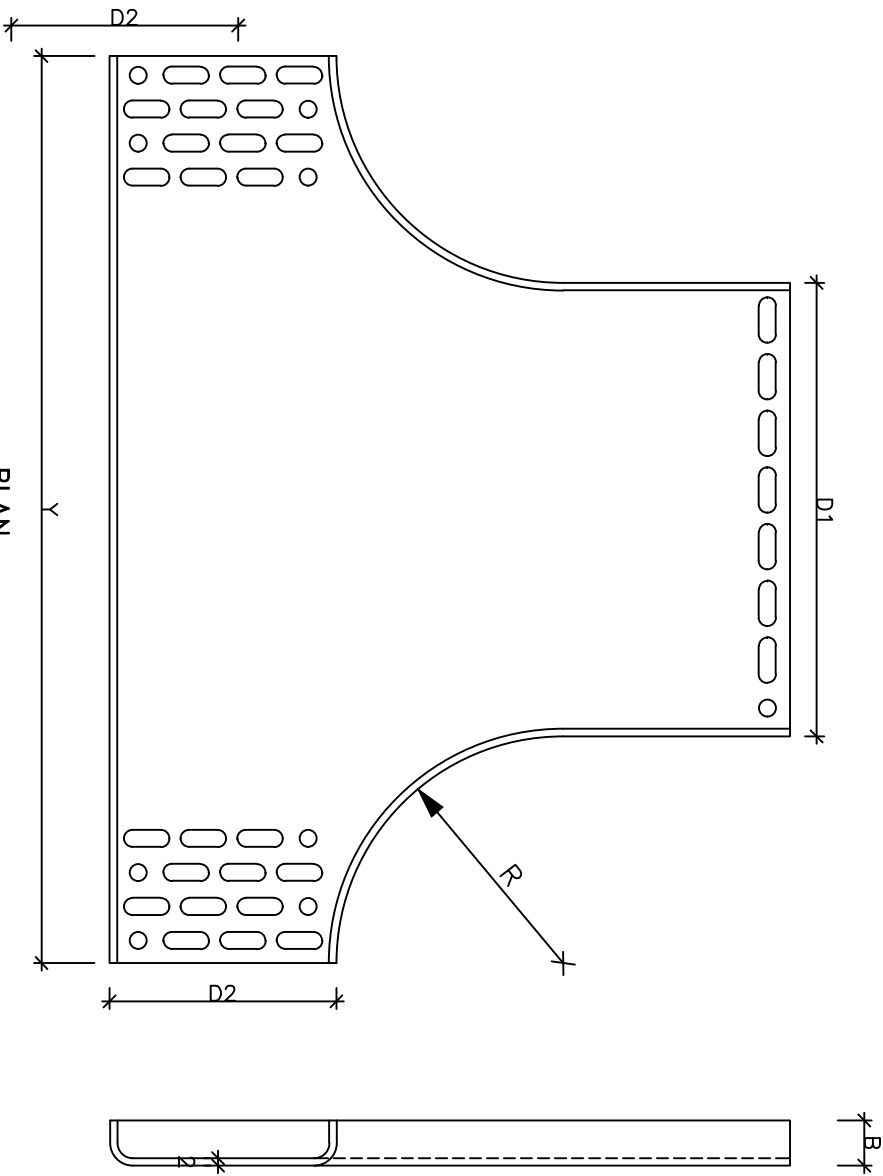
COUPLING PLATE

**PERFORATED TRAY JOINING BY
COUPLING PLATES**

- NOTES:-**
1. COUPLING PLATES 2 MM THICK M.S.
 2. ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

				 CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
DS	SM	BG	-	12.02.19	NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	SCALE : NTS
APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0400	REV.
							SHT. 15 OF 28	







VERTICAL ELBOW (90°)

TYPE	DIMENSIONS IN MM				
	D1	D2	B	R	Y
A	225	100	50	150	500
B	300	150	50	200	600

PERFORATED TRAY FITTINGS

FOR TENDER PURPOSE ONLY

				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
CABLING NOTES & DETAILS							
DS	SM	BG	-	12.02.19			
APPVD.	REVWD.	CHKD.	REV.	DATE			
				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
NOTES & DETAILS							
2X500MW THERMAL POWER PLANT AT TUTICORIN				JOB NO. 18A09		SCALE : NTS	
AT TUTICORIN				DWG. NO. 18A09-DWG-E-0400		SH. 16 OF 28	
				REV.			

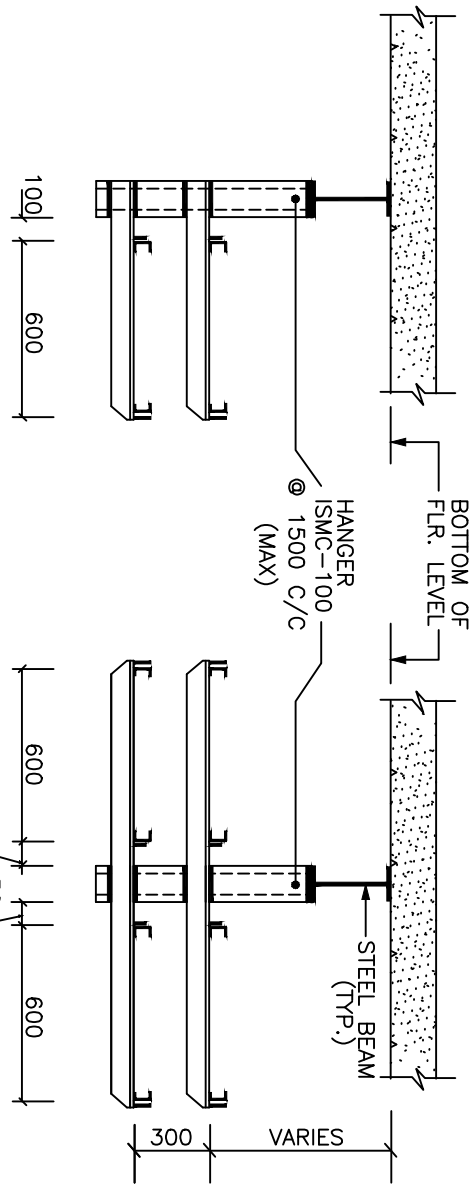
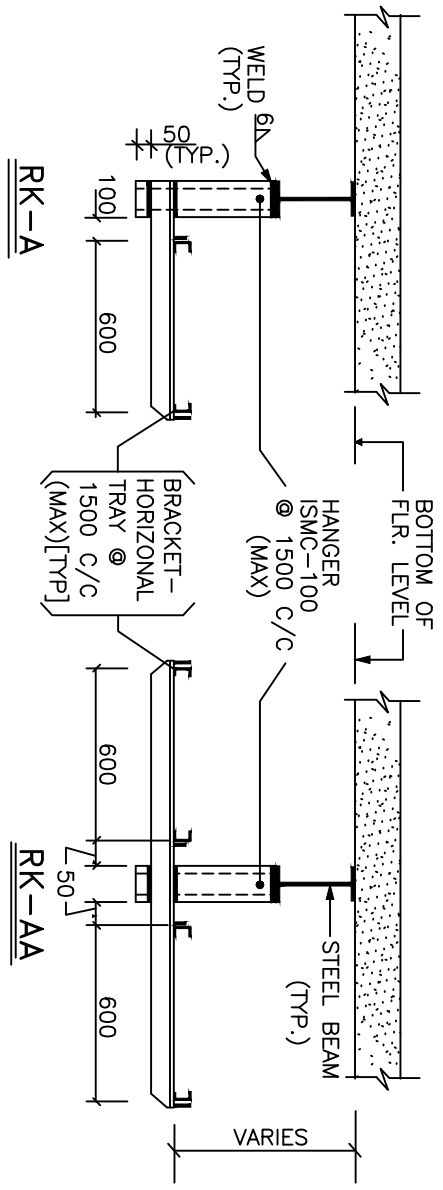


TABLE-1

RACK TYPE	WIDTH	NO. OF TIER
A1	450	1
B1	450	2
A2	300	1
B2	300	2

MOUNTING ARRANGEMENT
(FROM BEAM)

FOR TENDER PURPOSE ONLY

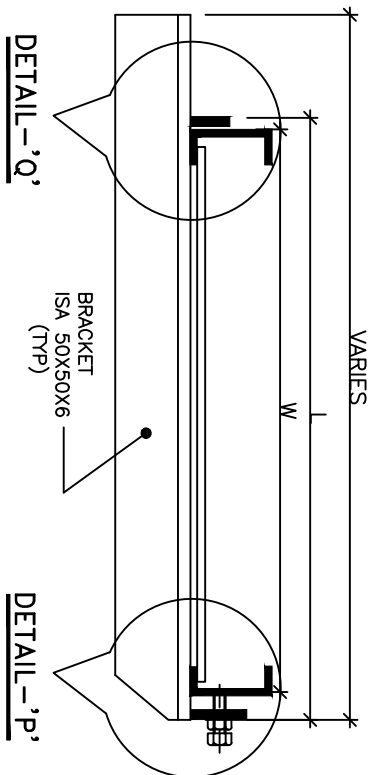
NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. FOR OVERHEAD CABLE TRAY GROUNDING REFER DWG.NO. K3A02-DWG-E0600
3. FOR RACK TYPE RK-C, RK-CC, RK-D, RK-DD ETC. THE ARRANGEMENT SHALL BE SIMILAR.

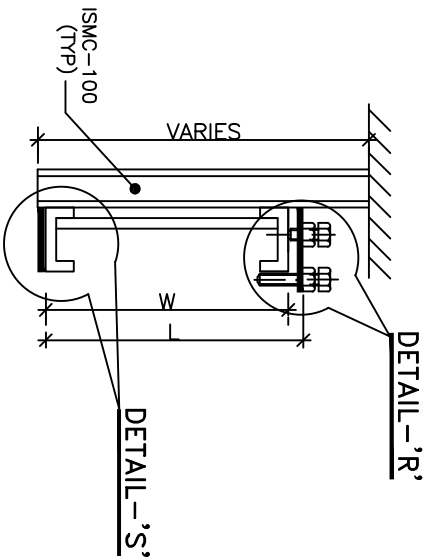
CABLING NOTES & DETAILS				NLC TAMILNADU POWER LIMITED			
APPVD.	REVMD.	CHKD.	REV.	DATE	DWG. NO.	SCALE :	REV.
DS	SM	BG	-	12.02.19	18A09	NTS	-
					18A09-DWG-E-0400		
					SH. 18 OF 28		

2X500MW THERMAL POWER PLANT AT TUTICORIN

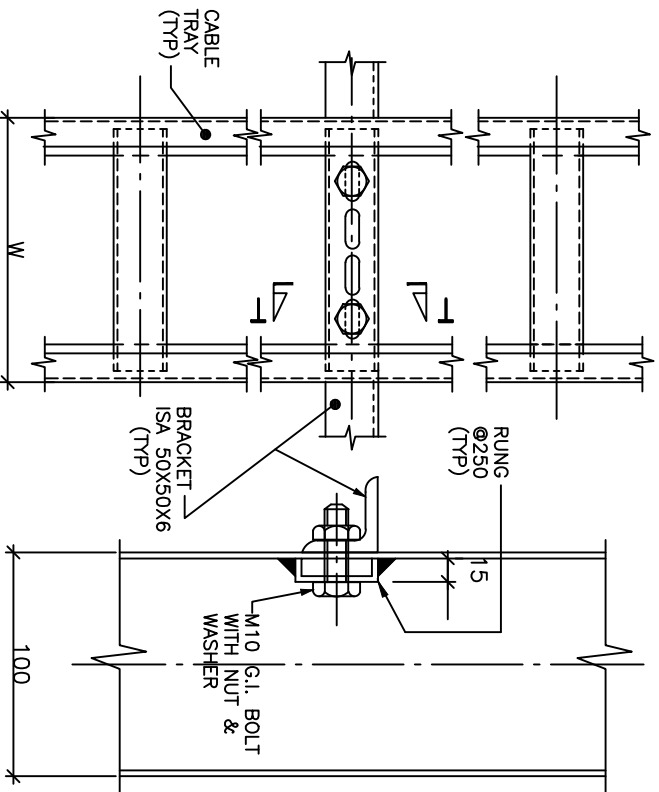
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS



BRACKET
(HORIZONTAL CABLE TRAY)

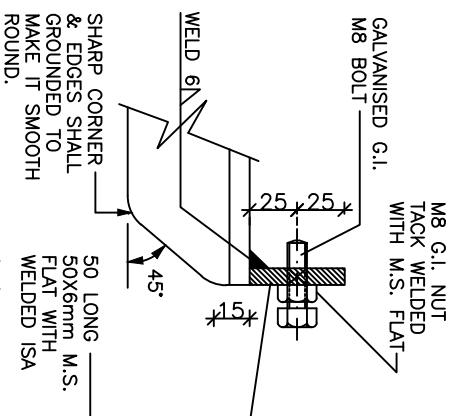


BRACKET
(VERTICAL CABLE TRAY)

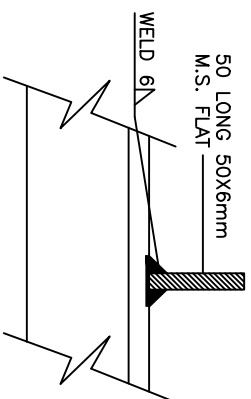


BRACKET
(VERTICAL CABLE SHAFT)

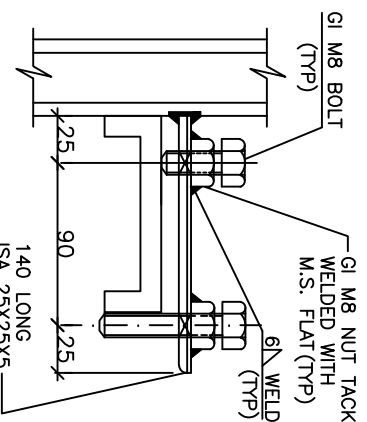
W	600	450	300
L	625	475	325



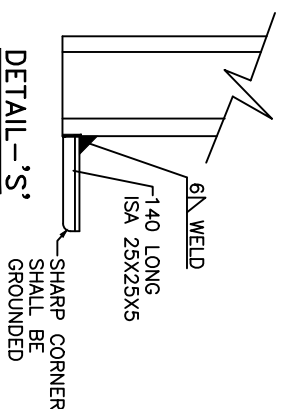
DETAIL-'P'



DETAIL-'Q'



DETAIL-'R'



DETAIL-'S'

FOR TENDER PURPOSE ONLY

DS	SM	BG	-	12.02.19
APPVD.	REWVD.	CHKD.	REV.	DATE

CABLING NOTES & DETAILS

NLC TAMILNADU POWER LIMITED

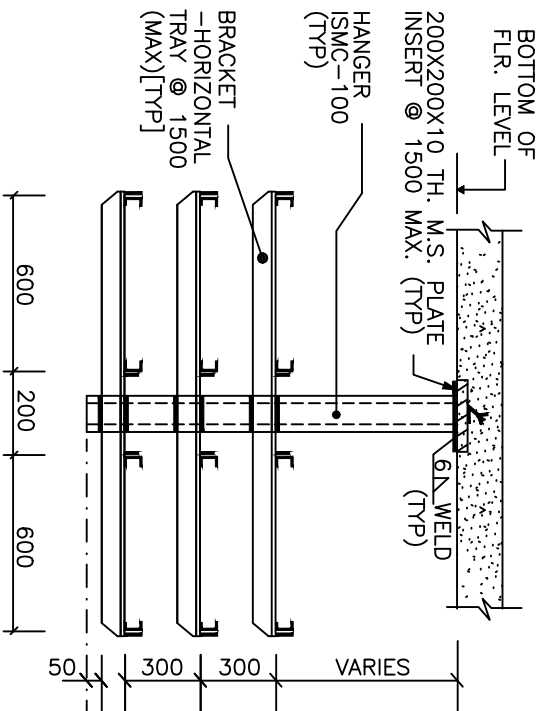
2X500MW THERMAL POWER PLANT AT TUTICORIN

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

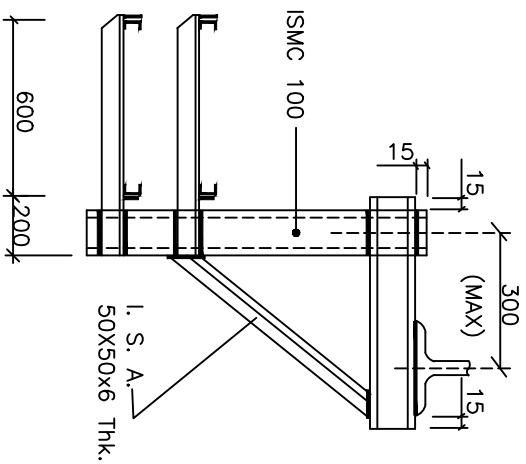
JOB NO. 18A09 SCALE : NTS

DWG. NO. 18A09-DWG-E-0400 REV. .

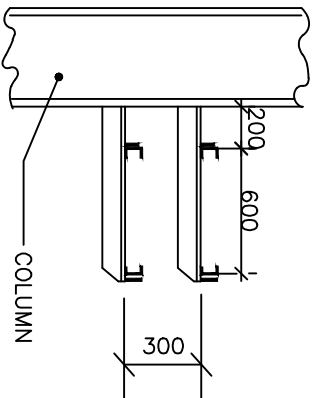
SHT. 19 OF 28



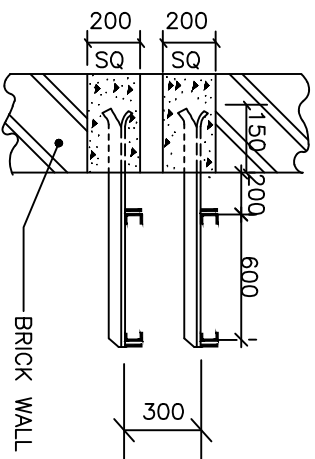
MOUNTING ARRANGEMENT
(FROM CEILING)



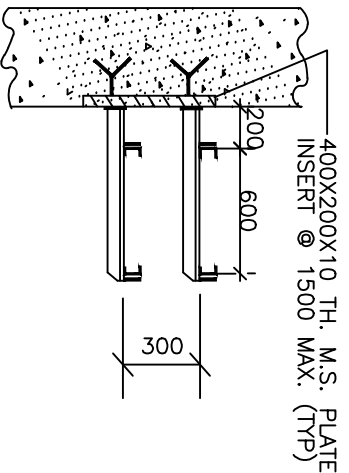
MOUNTING ARRANGEMENT
(FROM FLOOR BEAM)



MOUNTING ARRANGEMENT
(FROM STEEL COLUMN)



MOUNTING ARRANGEMENT
(FROM BRICK WALL)





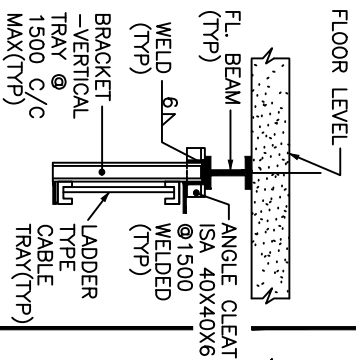
MOUNTING ARRANGEMENT
(FROM CONCRETE COLUMN)

NOTES :-

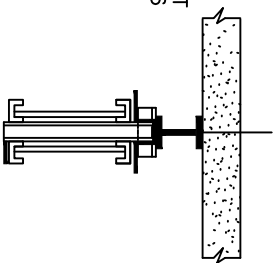
1. ALL DIMENSIONS ARE IN MM.
2. THE NOS. OF TIER AND WIDTH OF EACH TRAY SHALL BE AS PER RACK TYPE NOS.
3. FOR OVERHEAD CABLE TRAY GROUNDING REFER DWG.NO. K3A14-DWG-E-0600

FOR TENDER PURPOSE ONLY

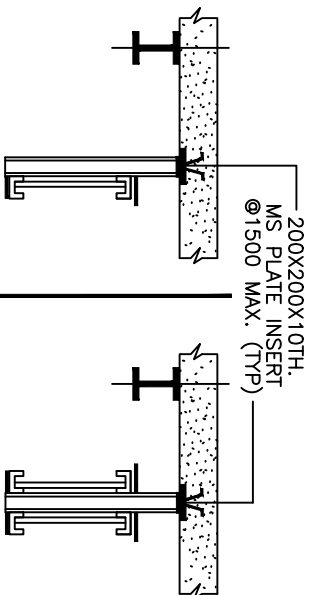
				 CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE			DWG. NO. 18A09-DWG-E-0400	REV.
							SHT. 20 OF 28	



STYLE-1

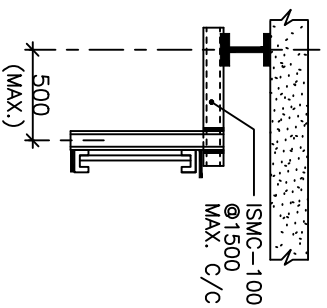


STYLE-2

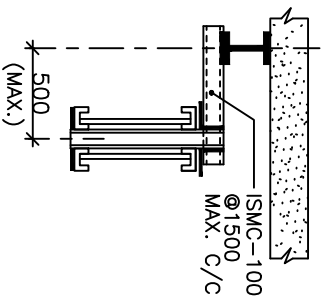


STYLE-3

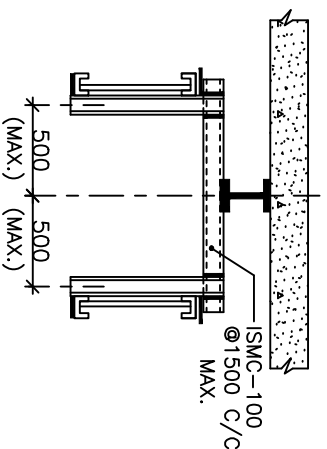
STYLE-4



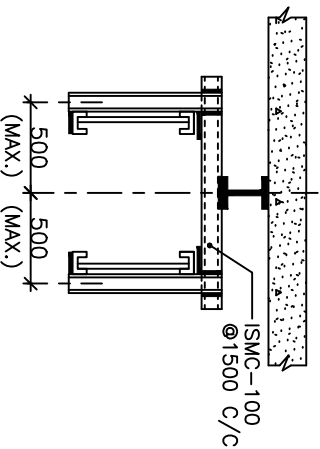
STYLE-5



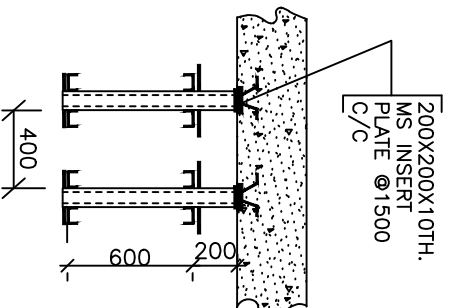
STYLE-6



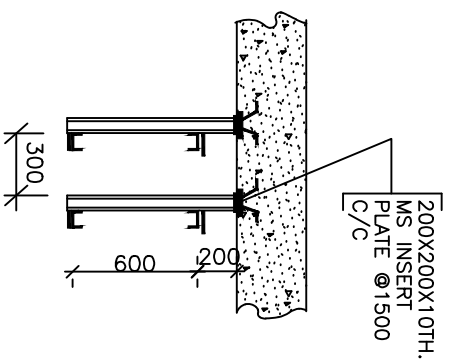
STYLE-7



STYLE-8



STYLE-9

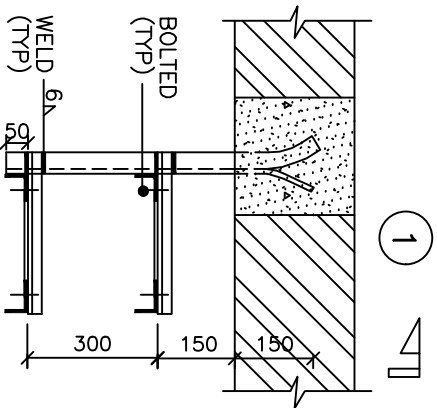


STYLE-10

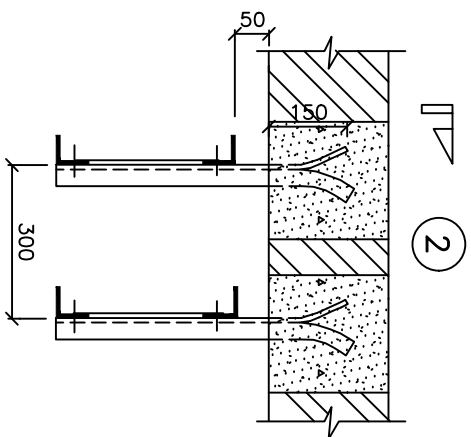
MOUNTING ARRANGEMENT
(VERTICAL CABLE TRAY)

FOR TENDER PURPOSE ONLY

<p>CABLING NOTES & DETAILS</p> <p>NILC TAMILNADU POWER LIMITED</p>				<p>DEVELOPMENT CONSULTANTS PVT. LTD.</p> <p>CONSULTING ENGINEERS</p>					
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09	SCALE : NTS	DWG. NO. 18A09-DWG-E-0400	REV.
APPVD.	REVWD.	CHKD.	REV.	DATE					

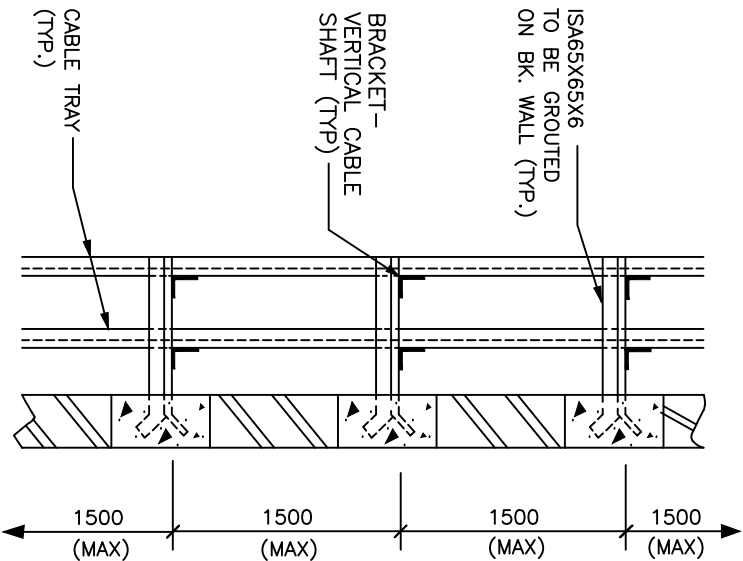


1

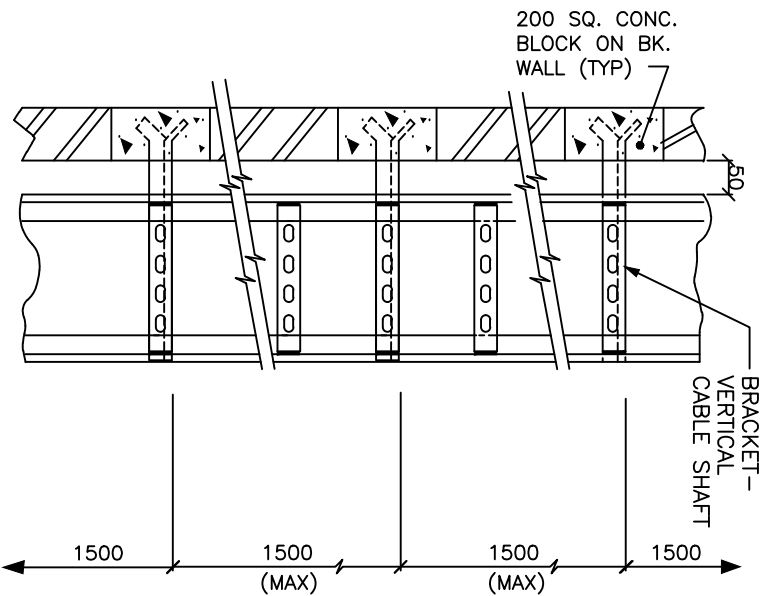


2

PLAN
ALT.1



PLAN
ALT.2



SEC:1-1

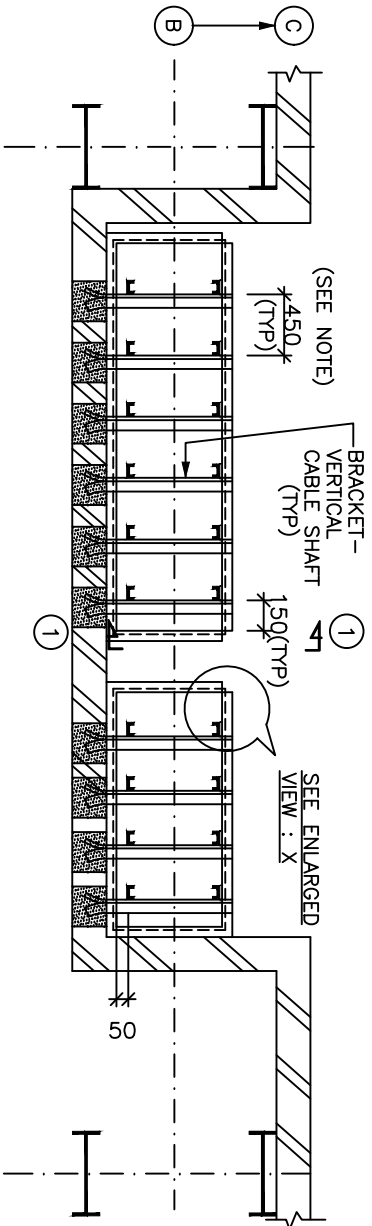
SEC:2-2

**MOUNTING ARRANGEMENT
(CABLE SHAFT ON BRICKWALL)**

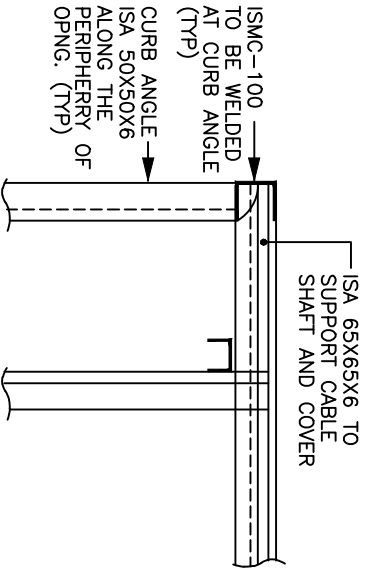
NOTE
FOR CABLE SHAFT OF TYPE SH-A,
SH-C, THE ARRANGEMENT SHALL BE
SIMILAR TO SH-B SHOWN HERE IN.

FOR TENDER PURPOSE ONLY

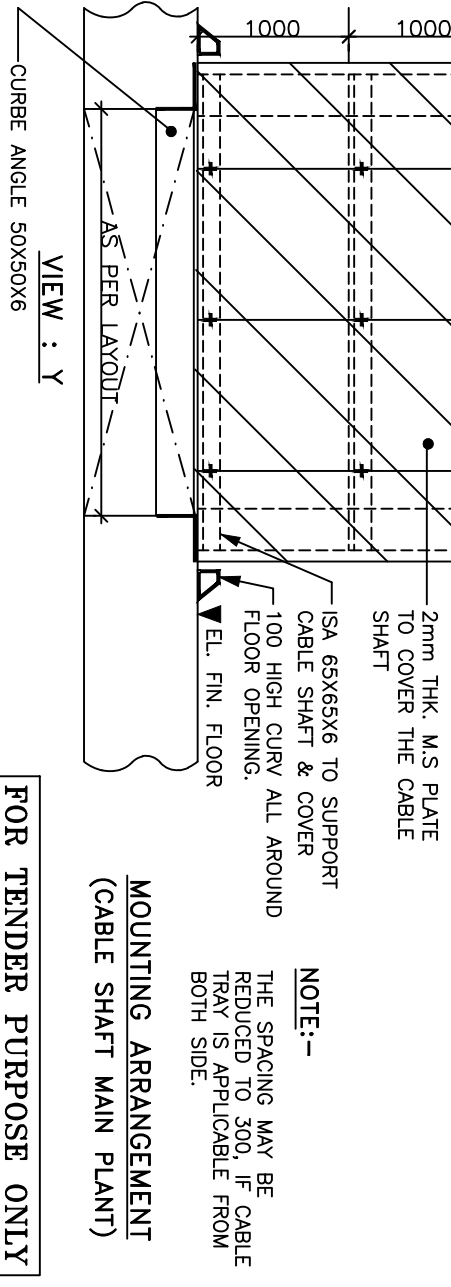
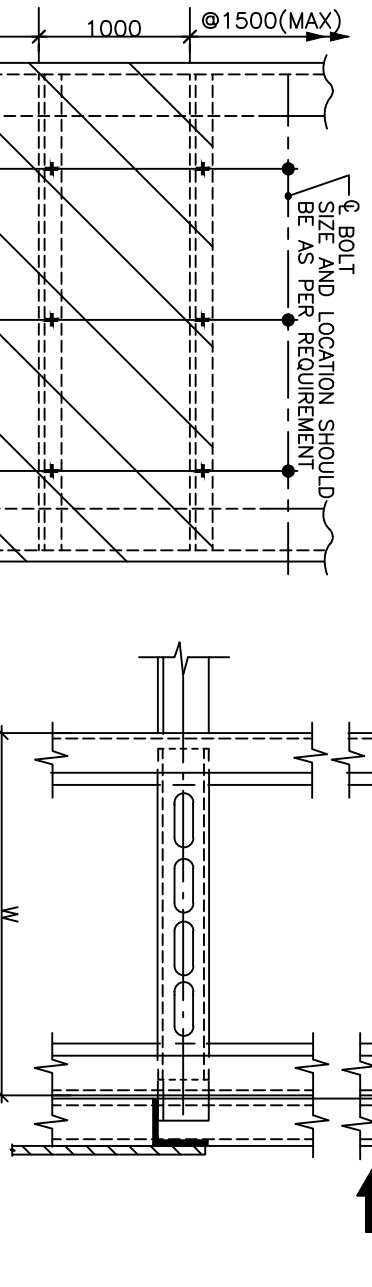
CABLING NOTES & DETAILS				NLC TAMILNADU POWER LIMITED				DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
2X500MW THERMAL POWER PLANT AT TUTICORIN				JOB NO. 18A09				SCALE : NTS			
APPVD. REVWD. CHKD. REV. DATE				DWG. NO. 18A09-DWG-E-0400				SH. 22 OF 28			
DS	SM	BG	-	12.02.19							



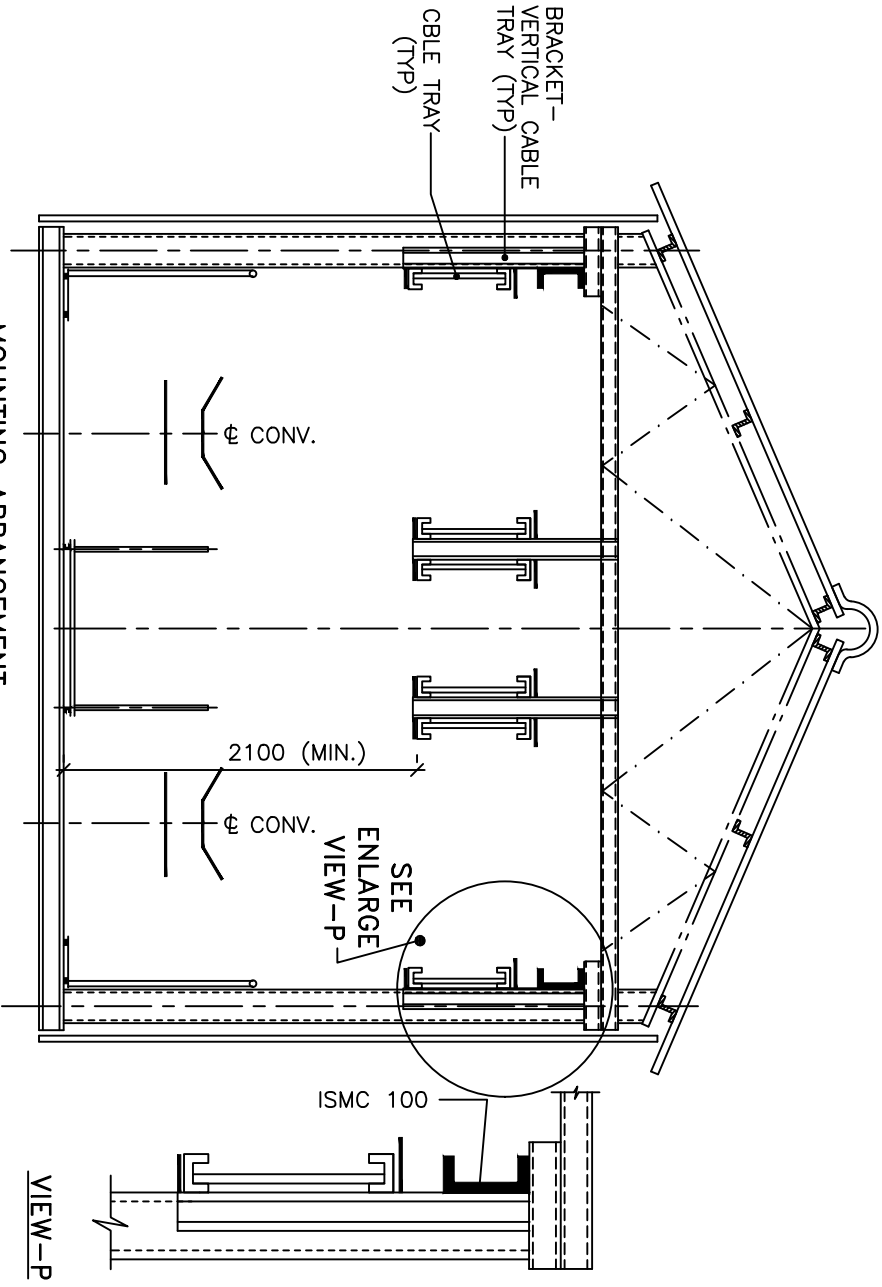
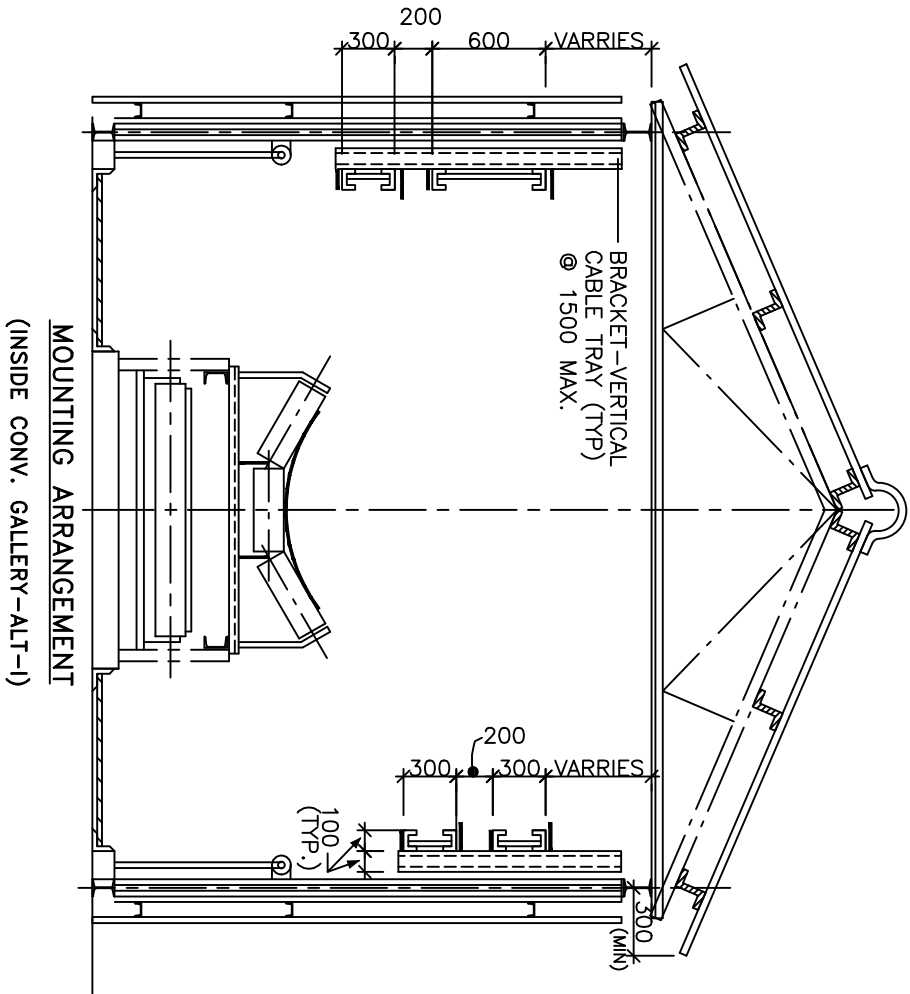
PLAN AT EL.3.5M



ENLARGED VIEW : X
TYPICAL DETAILS OF CABLE SHAFT



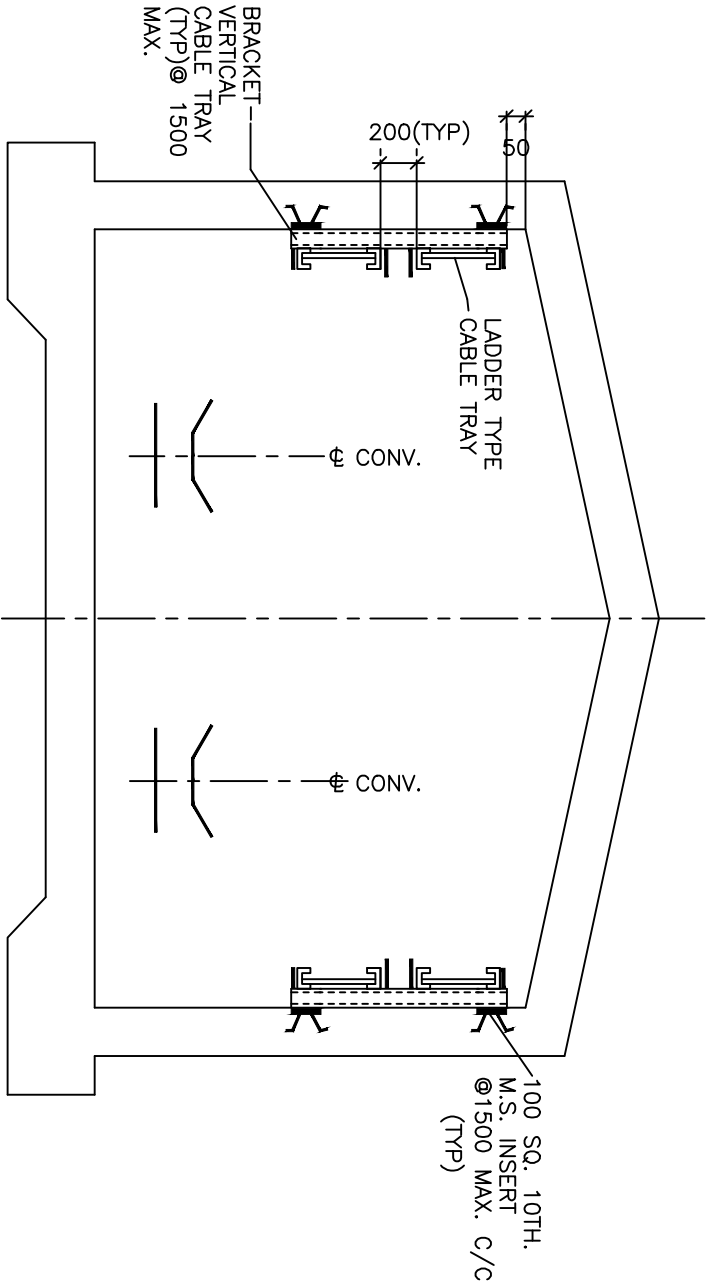
<p style="text-align: center;">CABLING NOTES & DETAILS</p>				<p style="text-align: center;">NLC TAMILNADU POWER LIMITED</p>		<p style="text-align: center;">DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS</p>	
APPVD.	REVWD.	CHKD.	REV.	DATE	JOB NO.	SCALE	REV.
SM	BG	-	-	12.02.19	18A09	NTS	
<p style="text-align: center;">2X500MW THERMAL POWER PLANT AT TUTICORIN</p>				<p style="text-align: center;">DWG. NO. 18A09-DWG-E-0400 SHT. 23 OF 28</p>			



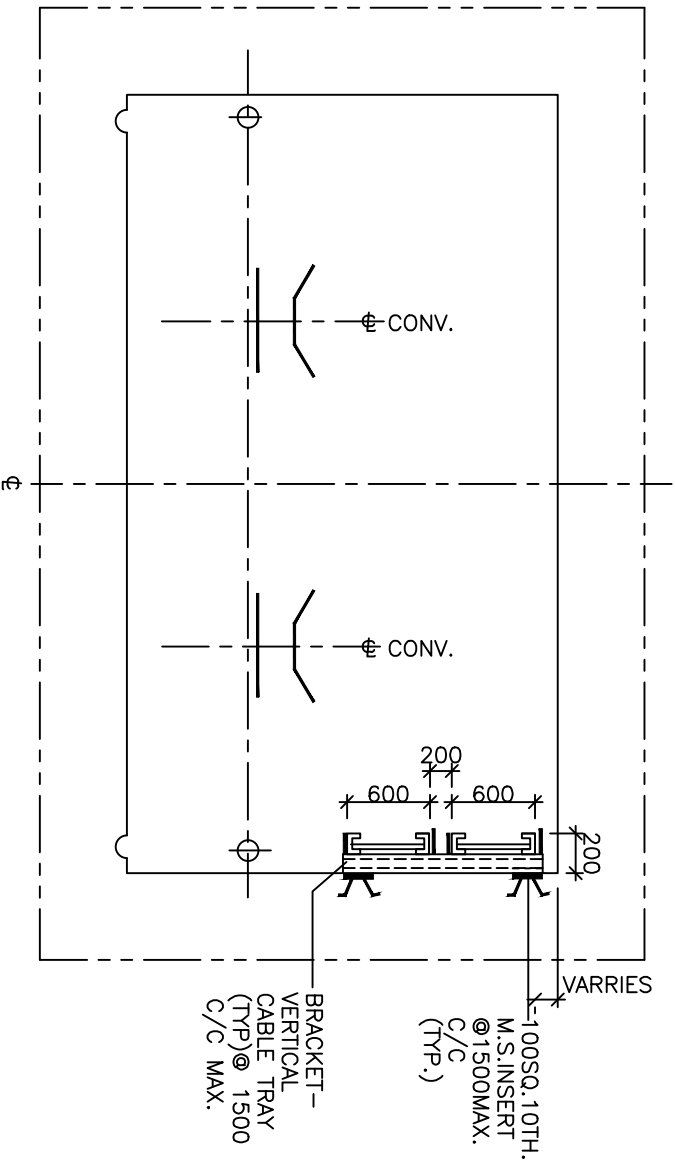
MOUNTING ARRANGEMENT
(INSIDE CONV. GALLERY-ALT-1)

FOR TENDER PURPOSE ONLY

DS	SM	BG	-	12.02.19	<p>NLC TAMILNADU POWER LIMITED</p>	<p>DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS</p>
APPVD.	REVWD.	CHKD.	REV.	DATE			JOB NO. 18A09	SCALE : NTS
					<p>2X500MW THERMAL POWER PLANT AT TUTICORIN</p>	<p>DWG. NO. 18A09-DWG-E-0400</p>
						<p>SHT. 24 OF 28</p>
						<p>REV.</p>





**MOUNTING ARRANGEMENT
(IN CONVEYOR TUNNEL-ALT-1)**

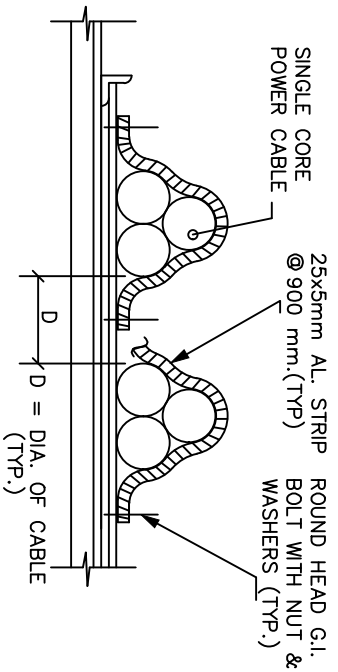


**MOUNTING ARRANGEMENT
(IN CONVEYOR TUNNEL-ALT-II)**

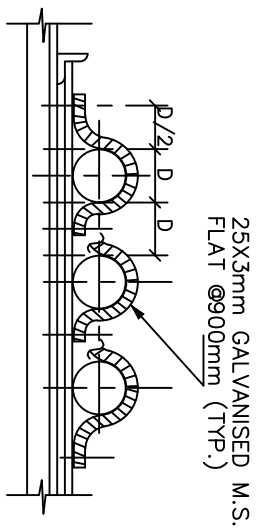
NOTE:-
ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

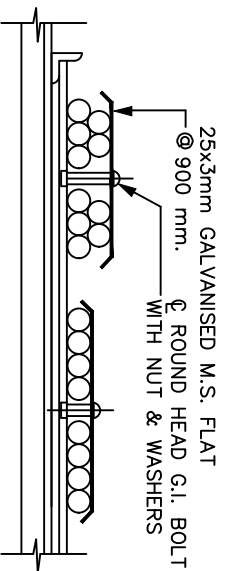
				 CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0400	
APPVD.	REVWD.	CHKD.	REV.	DATE	SCALE :	NTS	REV.
DS	SM	BG	-	12.02.19			



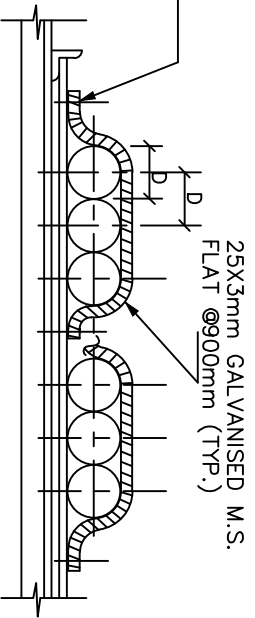
CABLE CLAMPS IN TREFOIL FORMATION FOR SINGLE CORE POWER CABLES



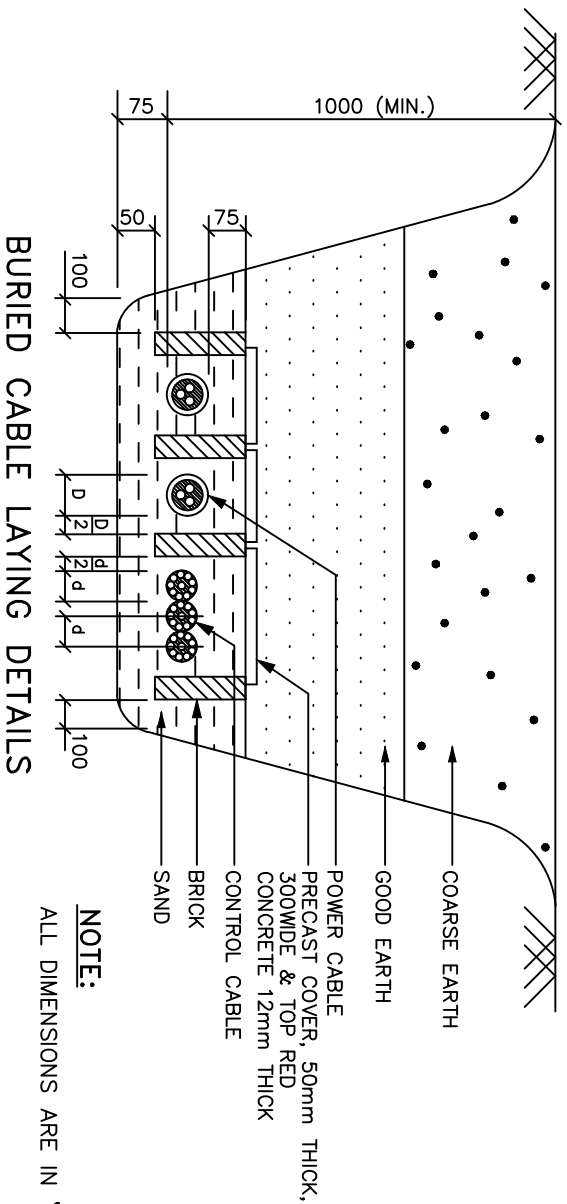
CABLE CLAMPS FOR MULTICORE POWER CABLES (NOT TOUCHING EACHOTHER)



CLAMPING ARRANGEMENT OF CONTROL CABLES





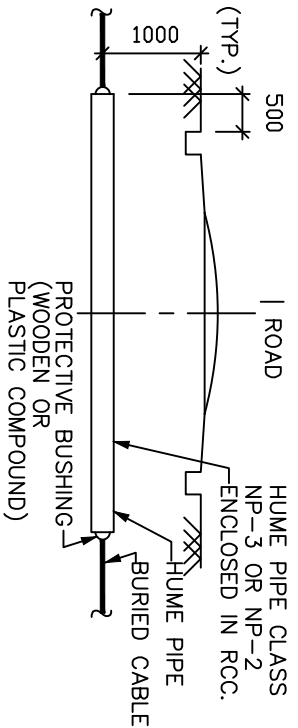
CABLE CLAMPS FOR MULTICORE POWER CABLES (TOUCHING EACHOTHER)



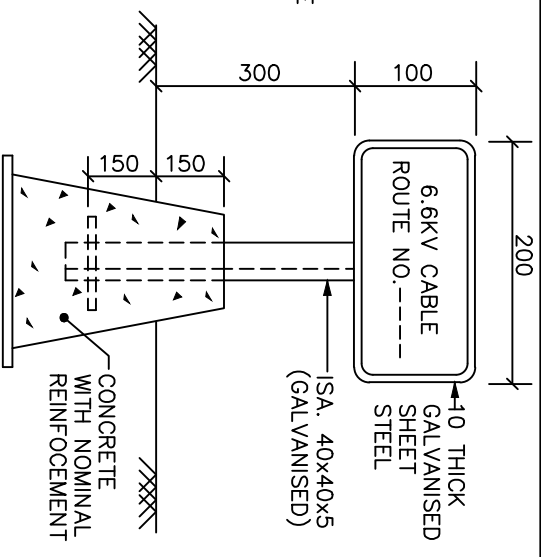
BURIED CABLE LAYING DETAILS

FOR TENDER PURPOSE ONLY

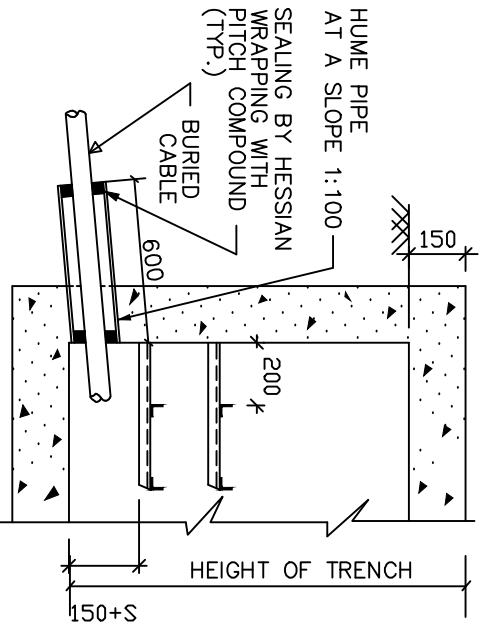
				 CABLING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		SCALE : NTS	
APPVD.	REVMD.	CHKD.	REV.	DATE	DWG. NO.	18A09-DWG-E-0400	REV.
DS	SM	BG	-	12.02.19	SHT.	26 OF 28	-



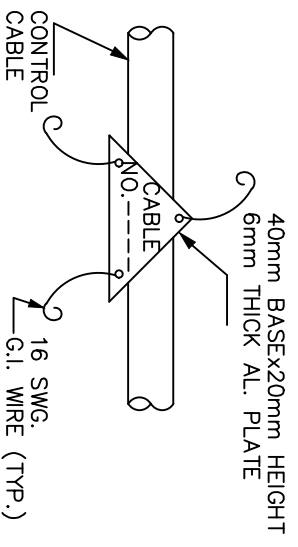
ROAD CROSSING OF BURIED CABLE



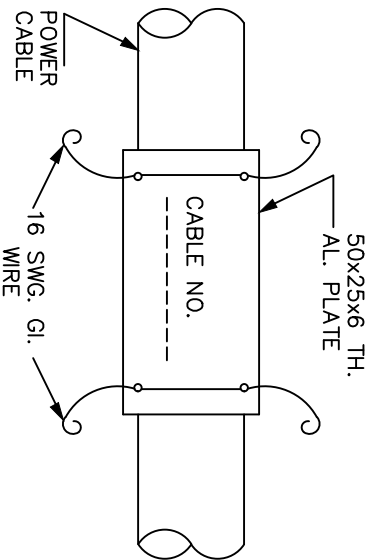
CABLE ROUTE MAKER (VOLTAGE TO BE MARKED)



TYP. DETAILS OF BURIED CABLE ENTRY TO BLDG. OR CABLE TRENCH





CABLE TAG CONTROL CABLE

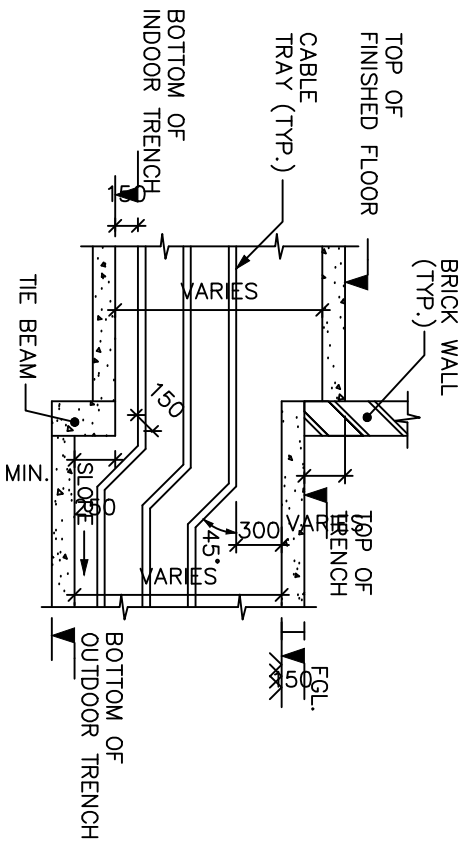


CABLE TAG POWER CABLE

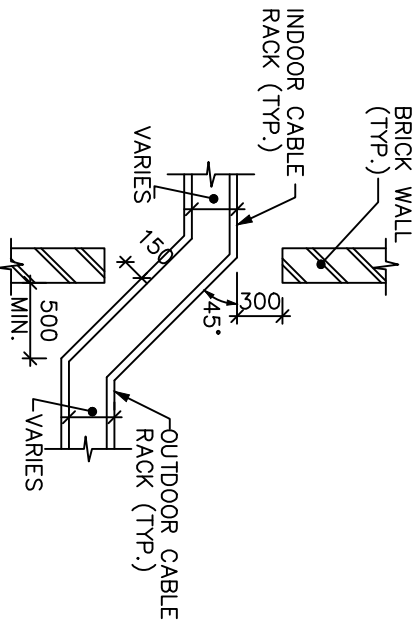
NOTE:
ALL DIMENSIONS ARE IN 'MM'.

FOR TENDER PURPOSE ONLY

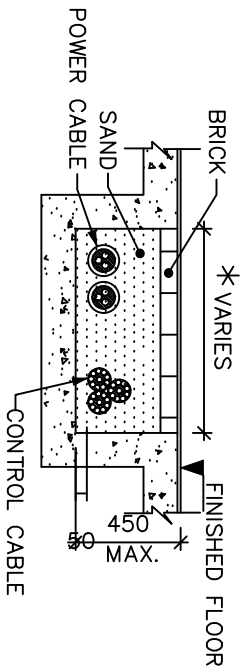
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				NLC TAMILNADU POWER LIMITED			
				2X500MW THERMAL POWER PLANT AT TUTICORIN			
DS	SM	BG	-	12.02.19			
APPVD.	REVMD.	CHKD.	REV.	DATE			



TYPICAL DETAILS OF CABLE TRENCH ENTRY TO BUILDING





TYPICAL DETAILS OF CABLE RACK ENTRY TO BUILDINGS



CABLE LAYING IN SHALLOW TRENCH (INDOOR)

- NOTE:**
1. ALL DIMENSIONS ARE IN 'MM'.
 2. THE PORTION OF FLOOR ABOVE THE TRENCH MARKED * SHALL BE FINISHED WITH WEAK MORTAR.

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				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
CABLING NOTES & DETAILS							
APPVD.	REVMD.	CHKD.	REV.	DATE			
DS	SM	BG	-	12.02.19			
2X500MW THERMAL POWER PLANT AT TUTICORIN					JOB NO. 18A09 SCALE : NTS		
					DWG. NO. 18A09-DWG-E-0400 REV.		
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GROUNDING
NOTES & DETAILS



DWG. NO. 18A09-DWG-E-0600

FOR TENDER PURPOSE ONLY

GROUNDING NOTES

- 1.0 These grounding notes and details shall be read and construed in conjunction with grounding drawings and specification.
- 2.0 The grounding installation work shall conform to the requirements of the Indian Electricity Rules and code of Practice for Earthing (IS:3043) as amended up-to-date in India. For the work in other country, the statutory rules and code of practice in vogue there in shall be followed.
- 3.0 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below grade. A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trench/foundation/underground pipe at the crossing.
- 4.0 Ground grid conductors around a building/switchyard fence shall be buried outside the boundary at a minimum distance of 1200 mm.
- 5.0 A additional grid of 1500 mm x 1500 mm comprising of closely spaced (300 mmx300 mm) conductor at a depth of 300 mm from finished grade level shall be provided below the operating handle of Isolators Earth switches and Circuit Breaker operating boxes located in outdoor HV/EHV substation. This grid shall be connected to the main ground grid. The ground connection to operating handle shall be made of flexible connection.
- 6.0 The ground grid conductor below grade shall be of bare 40mm Ø mild steel rod. Ground electrode shall be 40mm Ø x 3000 mm long mild steel rod, driven into the ground and connected to the ground grid conductor.
- 7.0 Riser/pigtail from the ground grid shall be 40mm Ø mild steel rod and shall project 300 mm above grade/concrete floor level unless otherwise shown.
- 8.0 All ground connections below grade shall be made by electric arc welding with low hydrogen content electrode. Bending of the conductor where necessary shall be done by gas heating.
- 9.0 Above grade, 50 x 6 mm galvanised mild steel flats shall be run as main ground conductors along building steels, walls and cable trays and securely fixed to the same by welding/clamping at intervals not exceeding 1500 mm. The ground conductors shall be interconnected between them and to the main ground grid through risers.

FOR TENDER PURPOSE ONLY

					GROUNDING NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS
					 NLC TAMILNADU POWER LIMITED		
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE		DWG. NO. 18A09-DWG-E-0600 SHT. 01 OF 26	REV. -



18A09-DWG-E-0600 Sh. 01 OF 26 12.02.2019

A4_DD (9-96) [210x297]

10. All electrical equipment and associated non-current carrying metal works, supporting structures, building/boiler columns, fence, system neutrals, lighting masts/arresters shall be connected to the plant ground system.
11. Two separate and distinct ground connections shall be provided for grounding of electrical equipment frameworks.
12. Miscellaneous devices such as junction boxes, pull boxes, push-button stations, lockout switches, cable end boxes etc. shall be effectively grounded whether specifically shown or not.
13. Ground conductor connections above grade shall be generally made by electric arc welding. The connection shall be coated with cold galvanising/weather resistant paints.
14. Bolted connection shall be made only for grounding of equipment/ devices and some removable structures. The contact surfaces shall be thoroughly cleaned before connection to ensure good electrical contact.
15. A continuous 50 x 6 mm galvanised M.S flat ground conductor shall be installed along the cable raceway and securely attached to each tray section, forming a solidly grounded tray system.
16. A 16 Swg G.I. wire shall be run along the metallic conduit and shall be securely tied with the same at an interval 300 mm.

Grounding connection or wire jumpers shall be installed where flexible conduit is used to connect rigid conduit to equipment.
17. Crane rails shall be grounded at both ends. in addition all joints shall be bonded to provide electrical continuity.
18. Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten(10) meters. Fence gate shall be separately grounded with flexible connection to permit movement.
19. For shielding, the ground conductors shall be taken right upto the top along the structure/chimney and connected directly to the lightning masts.
20. The poles used for distribution line and / or street light shall be grounded at the bottom.

FOR TENDER PURPOSE ONLY



					GROUNDING NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS
					 NLC TAMILNADU POWER LIMITED		
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE		DWG. NO. 18A09-DWG-E-0600 SHT. 02 OF 26	REV. -

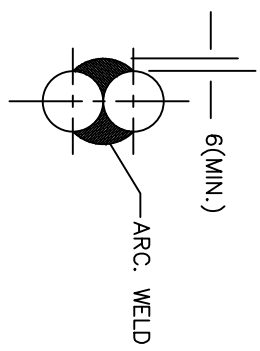
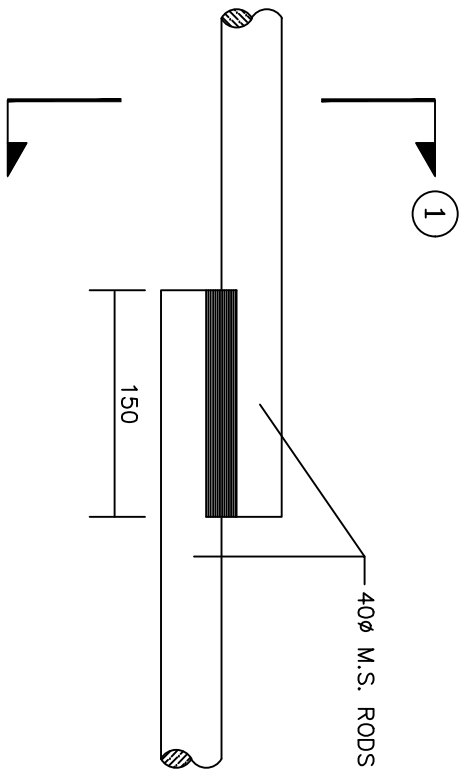
21. Ground electrodes shall be provided at connections with generator/ transformer neutrals, lightning arresters and lightning masts.

22. For ground connections, the conductor sizes shall be as listed below :-

Equipment	Galvanised mild steel flats
a. 400 KV and EHV equipment	: 50 x 6 mm
b. 11 kv, 3.3 KV equipment	: 50 x 6 mm
c. Structures, Cable trays etc.	: 50 x 6 mm
d. 415 V, P.C.C., M.C.C. etc.	: 50 x 6 mm
e. Motors above 90 KW, control panels	: 50 x 6 mm
f. Motors above 30 KW upto 90 KW, lighting panels, local panels	: 35 x 6 mm
e. Motors above 5 KW, 30 KW	: 25 x 3 mm
f. Motors upto 5 KW, Miscellaneous devices etc.	: No. 8 S.W.G. G.I. wire

FOR TENDER PURPOSE ONLY



					GROUNDING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
					 NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
					2X500MW THERMAL POWER PLANT AT TUTICORIN		SCALE : NTS	
DS	SM	BG	-	12.02.19			DWG. NO. 18A09-DWG-E-0600	
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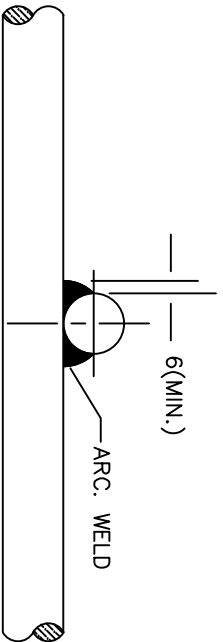
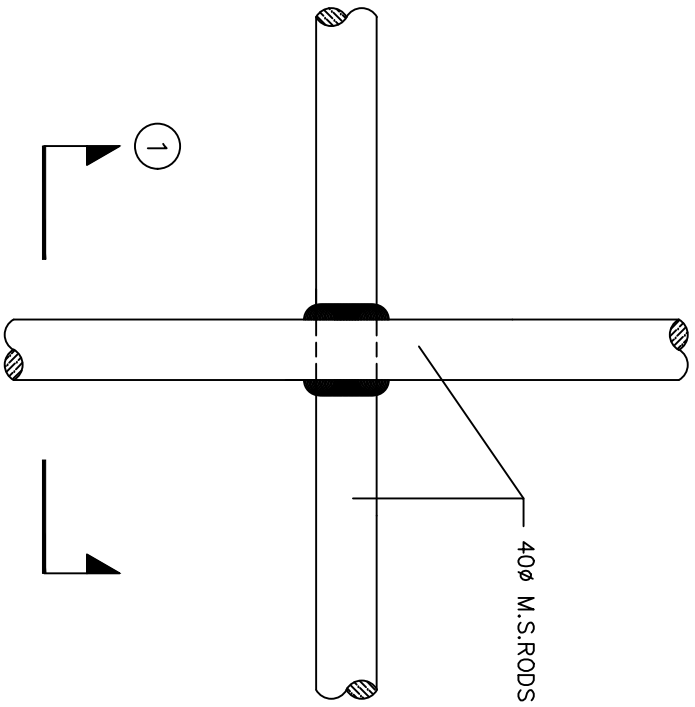


SECTION --(1)

LAP JOINT
BETWEEN M.S. RODS

FOR TENDER PURPOSE ONLY



				 GROUNDING NOTES & DETAILS	
				NLC TAMILNADU POWER LIMITED	
				2X500MW THERMAL POWER PLANT AT TUTICORIN	
		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
DS	SM	BG	-	12.02.19	
APPVD.	REVMD.	CHKD.	REV.	DATE	
JOB NO. 18A09			SCALE : NTS		
DWG. NO. 18A09-DWG-E-0600			REV. -		
SHT. 04 OF 26					

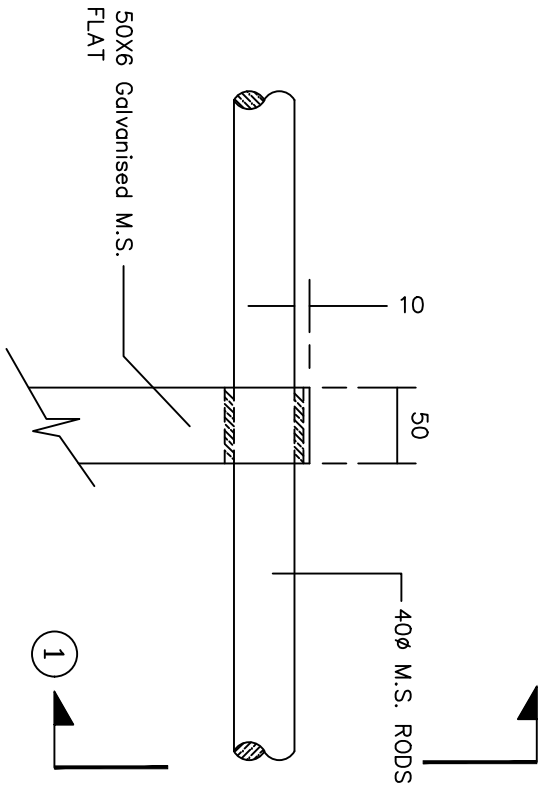


SECTION - ①

CROSS JOINT
BETWEEN M.S. RODS

FOR TENDER PURPOSE ONLY



				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
GROUNDING NOTES & DETAILS				JOB NO. 18A09		SCALE : NTS	
2X500MW THERMAL POWER PLANT AT TUTICORIN				DWG. NO. 18A09-DWG-E-0600		REV. -	
DS	SM	BG	-	12.02.19			
APPVD.	REVMD.	CHKD.	REV.	DATE			

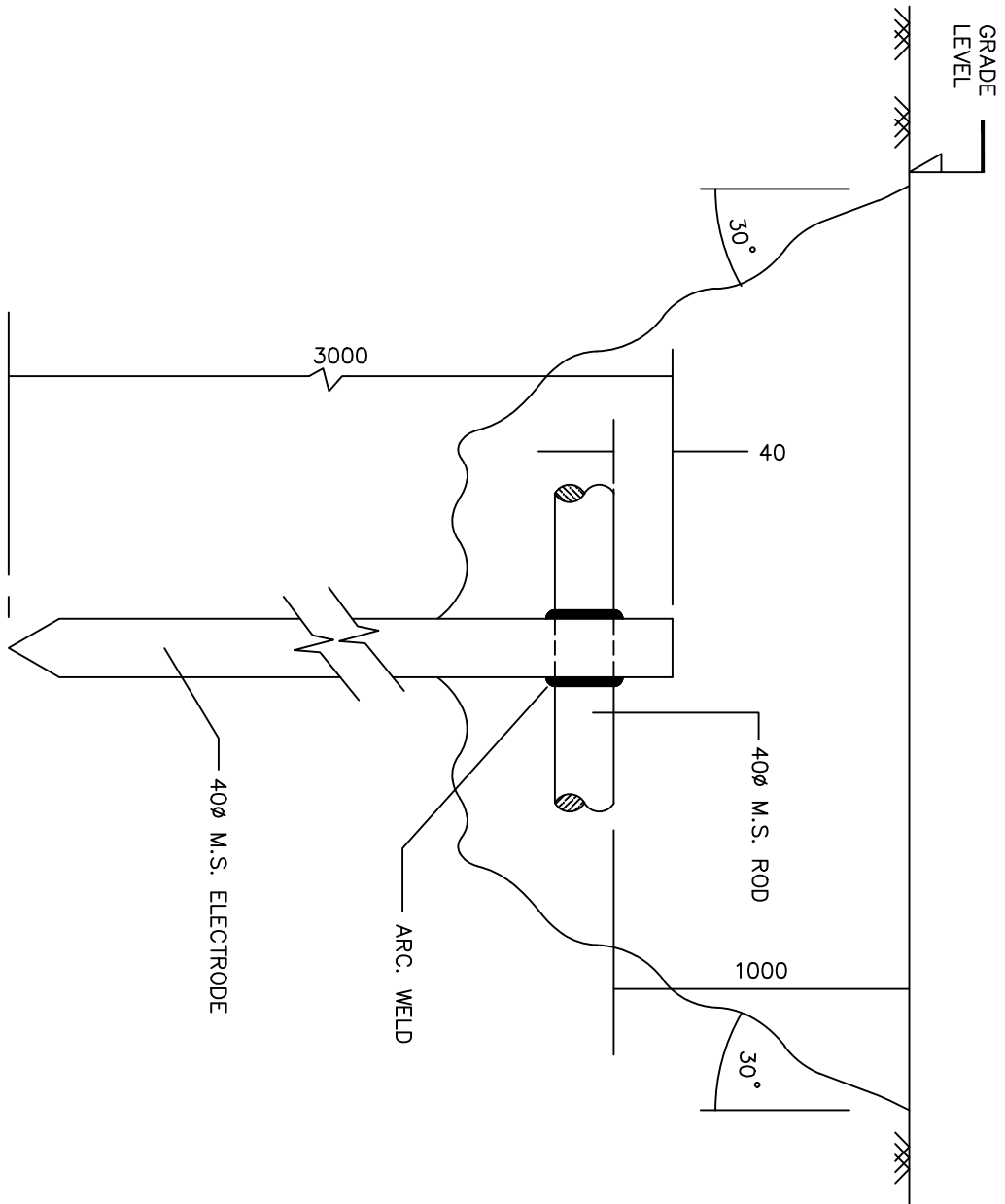


SECTION - ①

CROSS JOINT



FOR TENDER PURPOSE ONLY

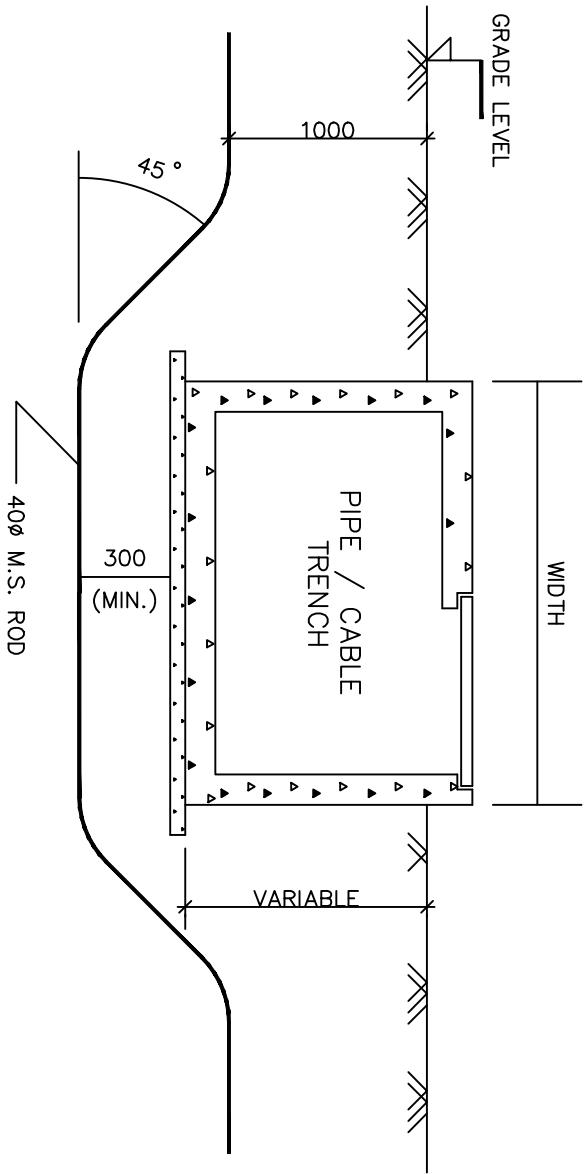
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APPVD.	REVMD.	CHKD.	REV.	DATE	
2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09		
			SCALE : NTS		
			DWG. NO. 18A09-DWG-E-0600		
			SHT. 06 OF 26		
			REV. -		



GROUND ELECTRODE



FOR TENDER PURPOSE ONLY

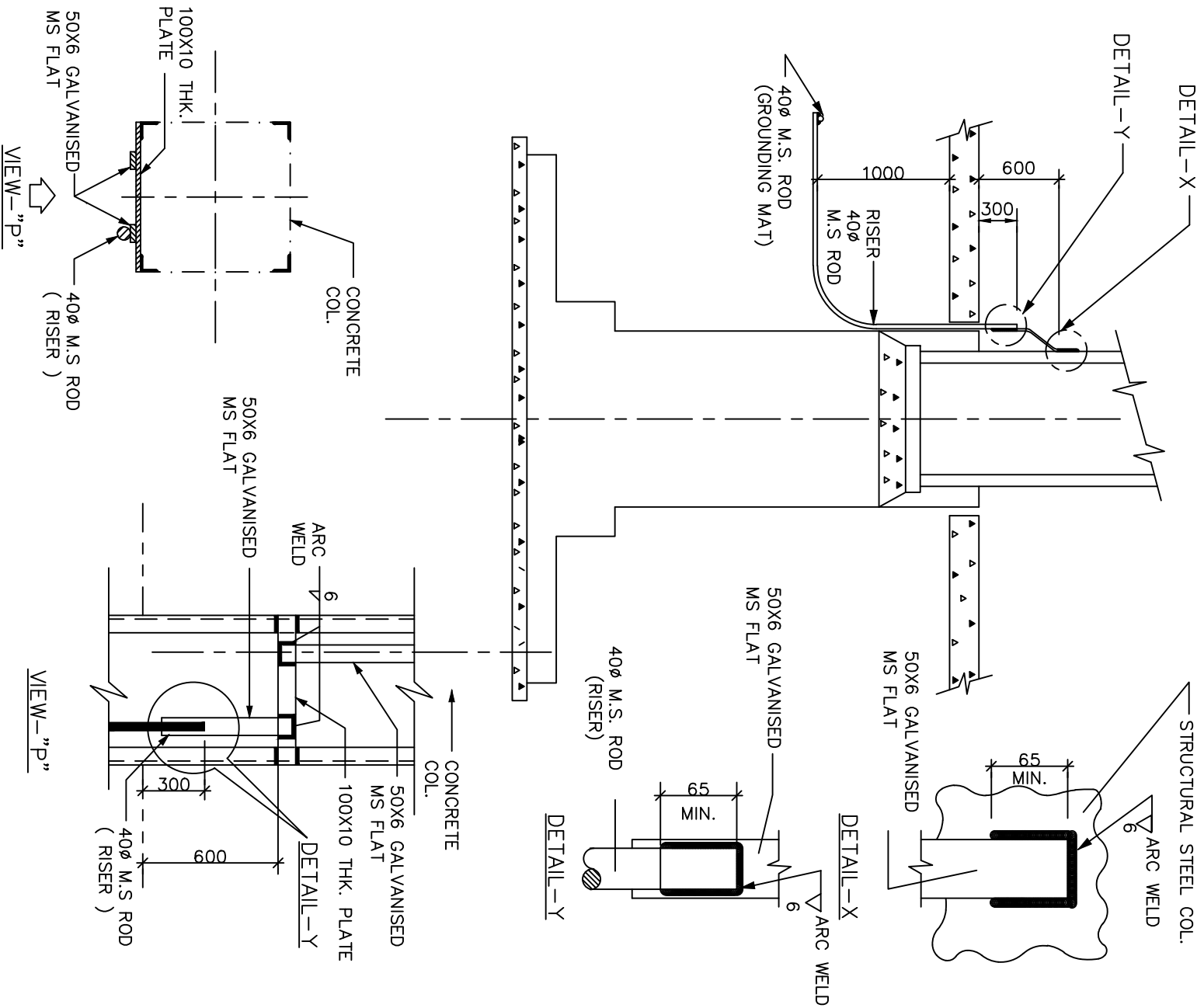
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APPVD.	REVMD.	CHKD.	REV.	DATE			DWG. NO.	18A09-DWG-E-0600	REV.	-
							SHT.	07 OF 26		



TRENCH CROSSING
OF GROUNDING CONDUCTOR



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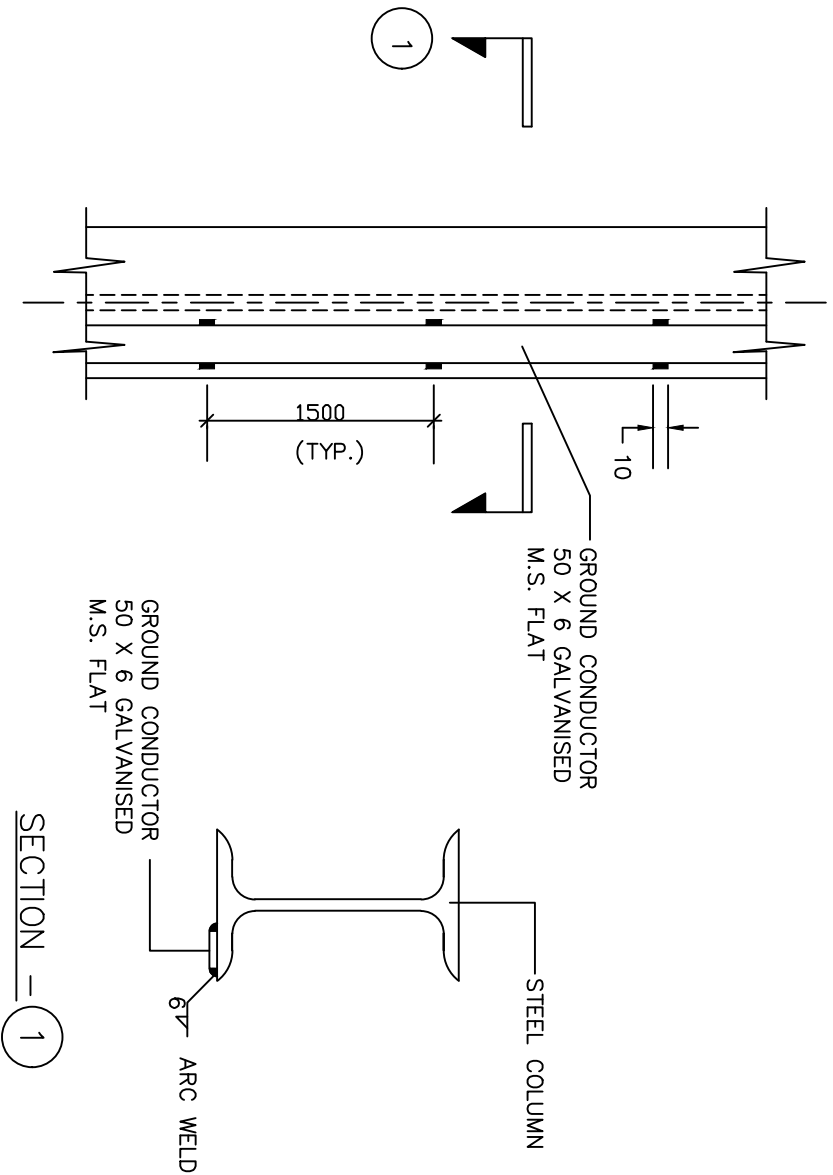
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NOTES & DETAILS							
2X500MW THERMAL POWER PLANT				SCALE : NTS			
AT TUTICORIN							
DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-0600		
APPVD.	REVMD.	CHKD.	REV.	DATE			
					REV.		



GROUNDING OF STEEL & CONCRETE COL.



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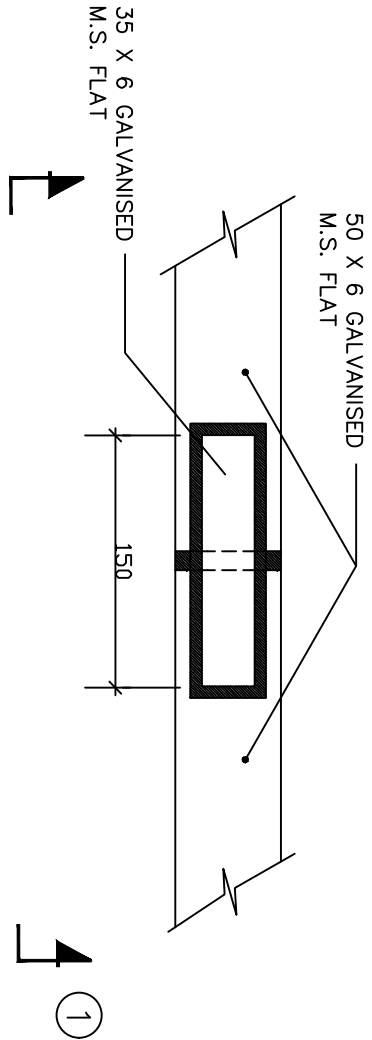
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2X500MW THERMAL POWER PLANT				DWG. NO. 18A09-DWG-E-0600			
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EARTHING CONDUCTOR
ALONG STEEL COLUMN

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				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
								GROUNDING NOTES & DETAILS
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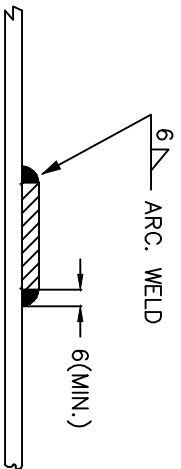
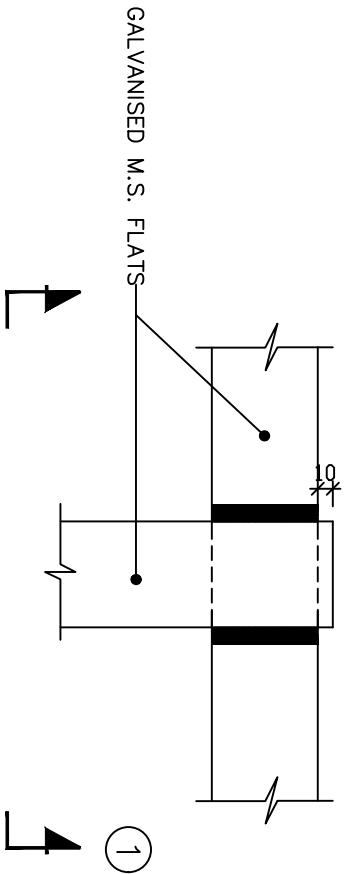


SECTION - ①

BUT JOINT
BETWEEN GALVANISED M.S. FLATS

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		 NILC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
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2X500MW THERMAL POWER PLANT AT TUTICORIN					
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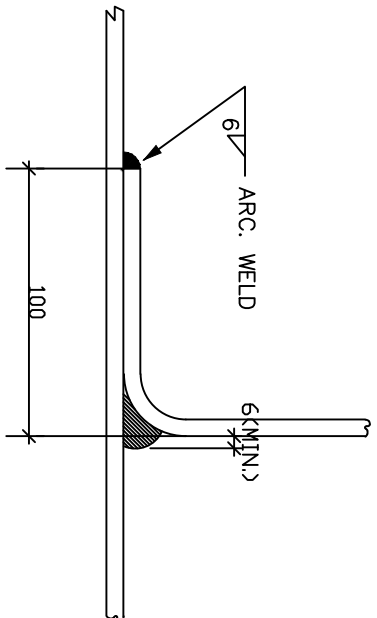
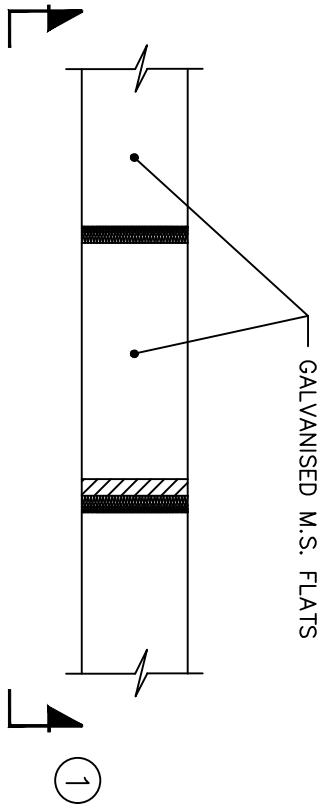


SECTION - ①

CROSS JOINT
BETWEEN GALVANISED M.S. FLATS

FOR TENDER PURPOSE ONLY



				 GROUNDING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09 SCALE : NTS	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0600 SH.T. 13 OF 26	
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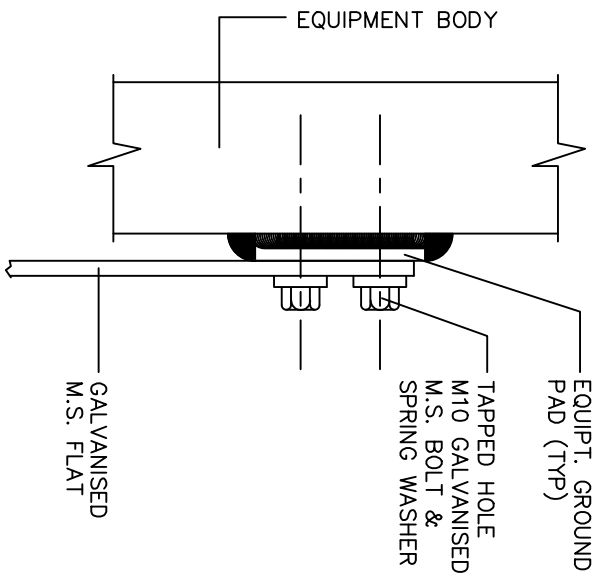
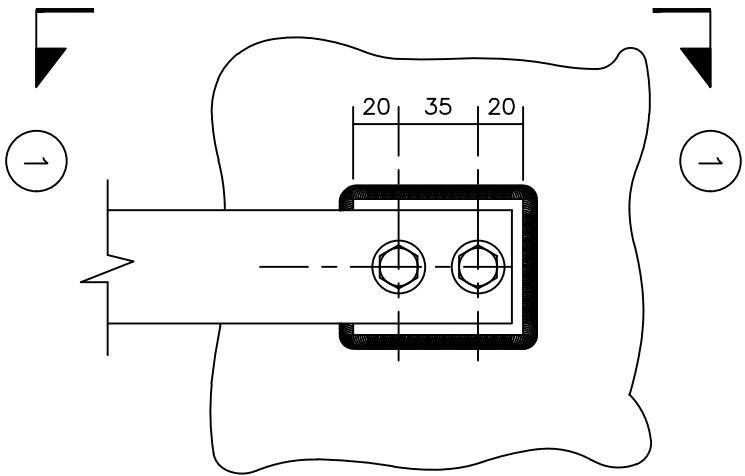


SECTION - ①

ANGULAR JOINT
BETWEEN GALVANISED M.S. FLATS

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				 GROUNDING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTTICORIN		SCALE : NTS	
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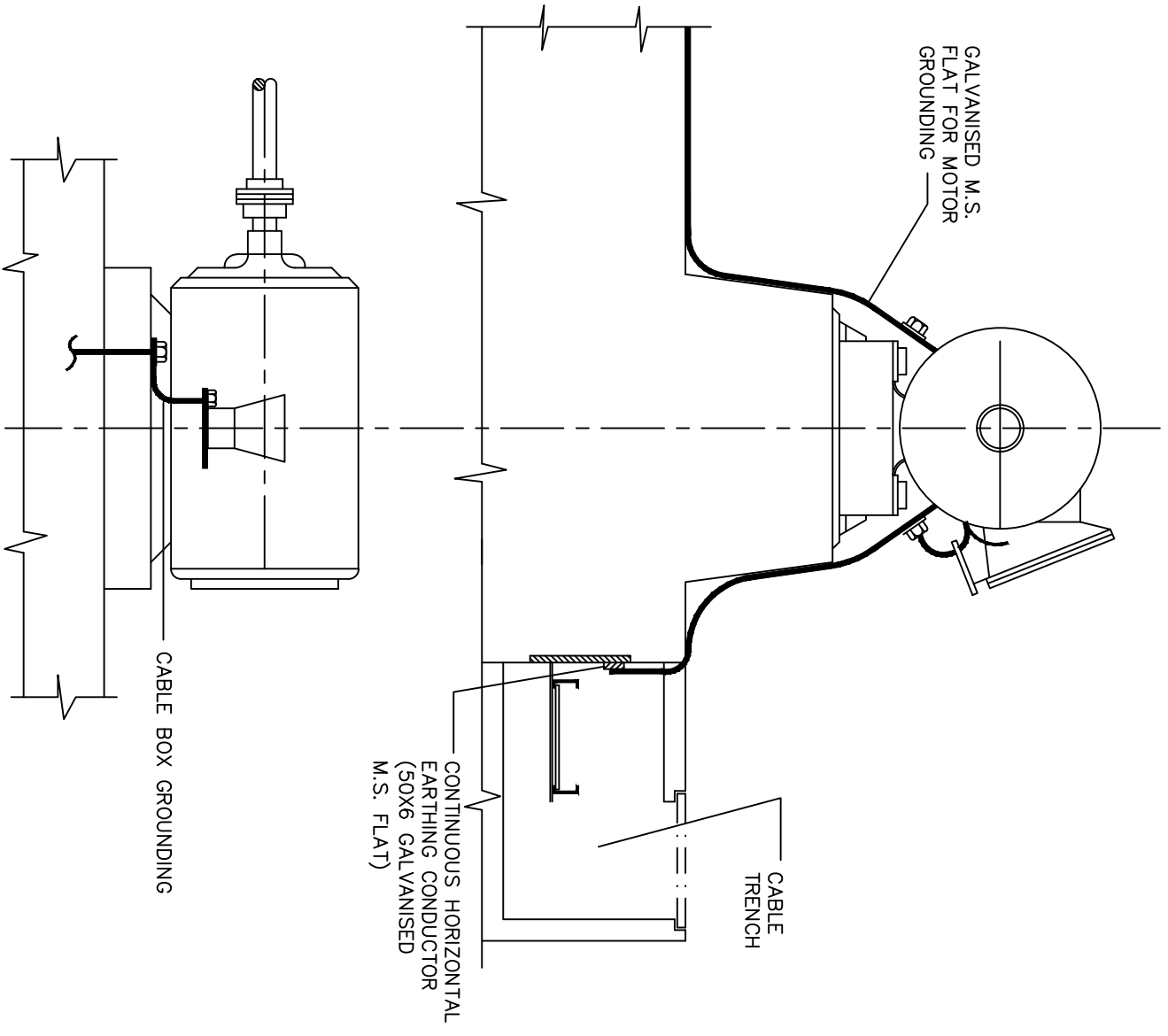


SECTION -- ①--①

EQUIPMENT GROUNDING



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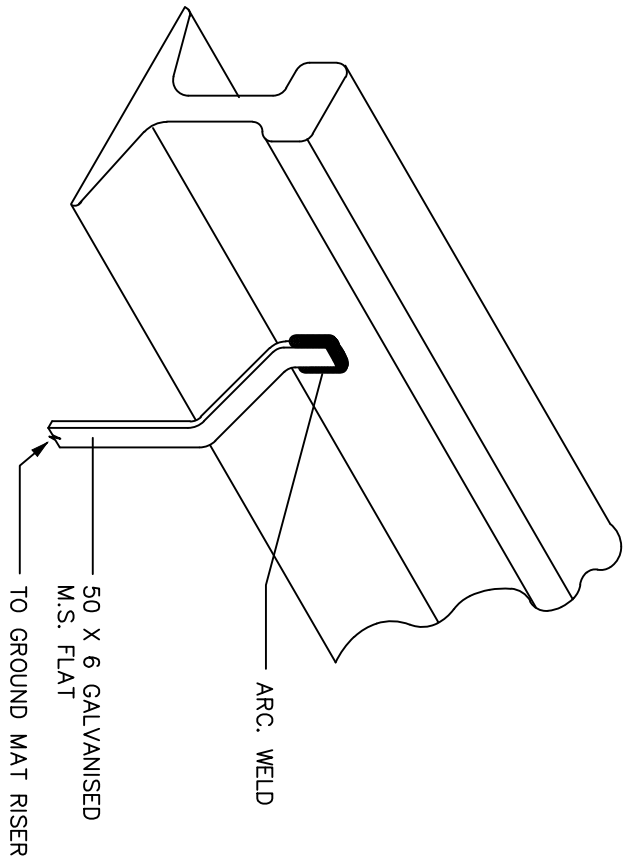
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2X500MW THERMAL POWER PLANT AT TUTICORIN					
JOB NO. 18A09		SCALE : NTS		DWG. NO. 18A09-DWG-E-0600	
				SHT. 16 OF 26	
				REV.	



MOTOR GROUNDING



FOR TENDER PURPOSE ONLY

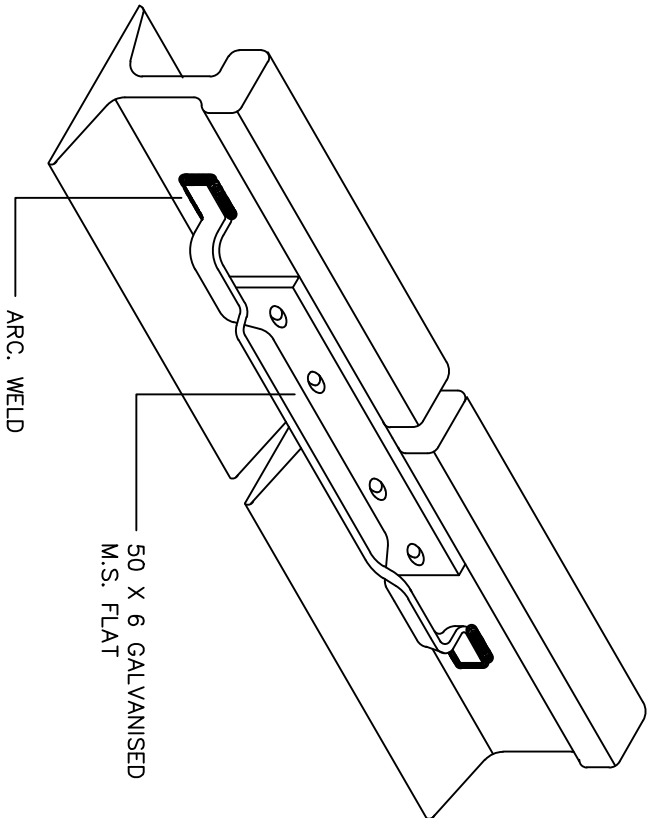
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DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-0600 SHT. 17 OF 26				



RAIL GROUNDING



FOR TENDER PURPOSE ONLY

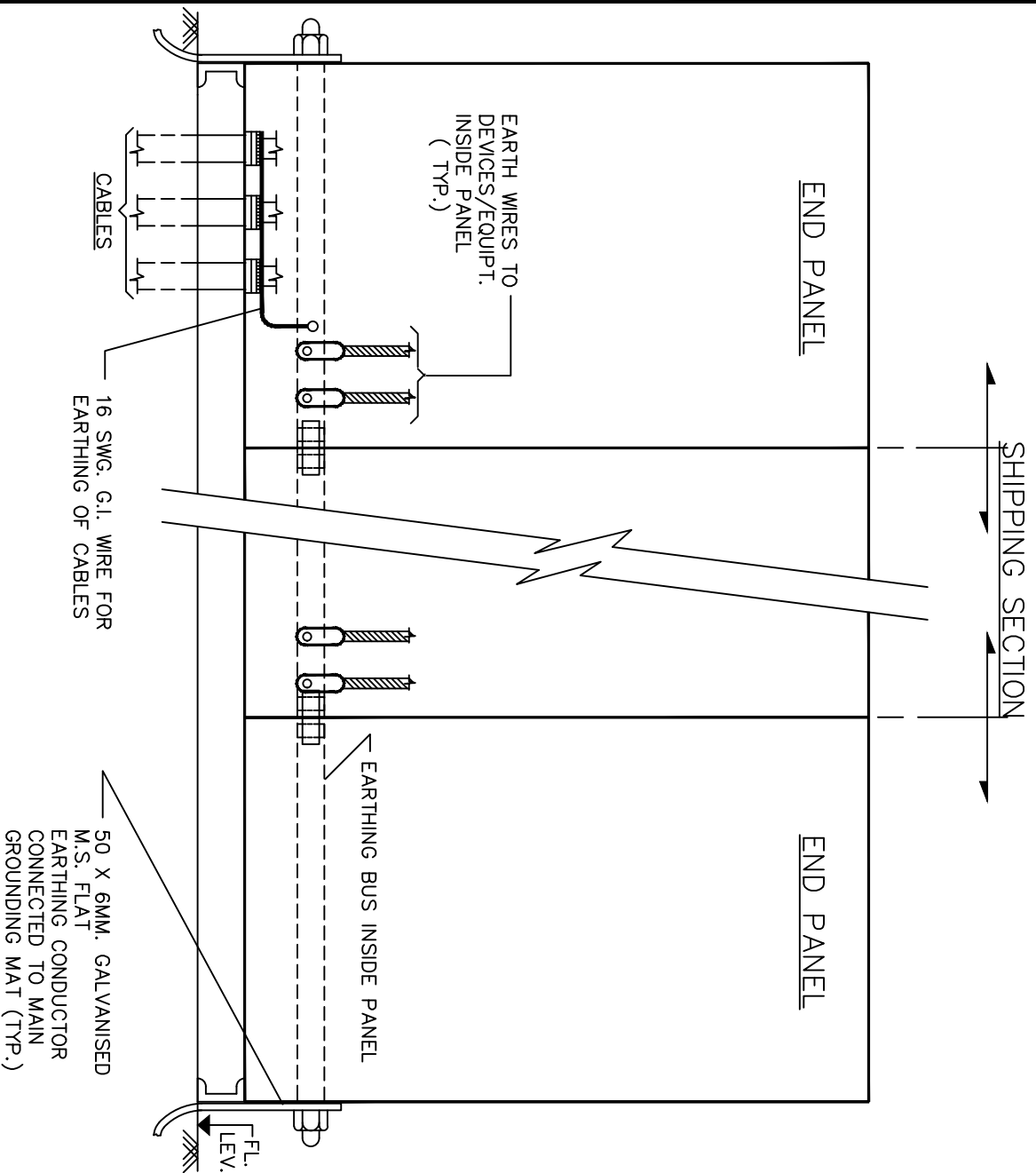
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DS	SM	BG	-	12.02.19					
JOB NO. 18A09 SCALE : NTS					DWG. NO. 18A09-DWG-E-0600 REV. -				
					SH. 18 OF 26				



RAIL BONDING



FOR TENDER PURPOSE ONLY

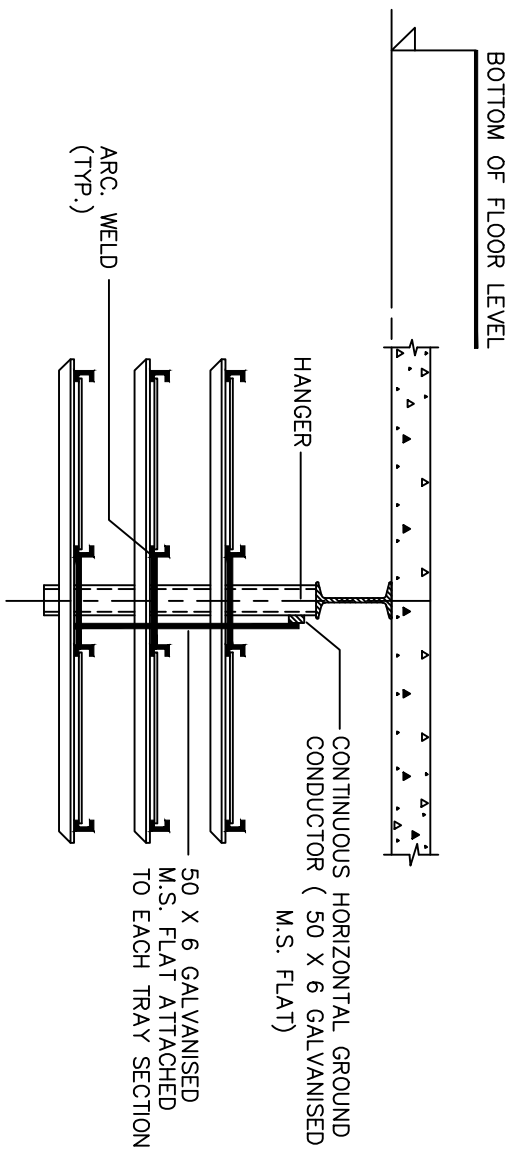
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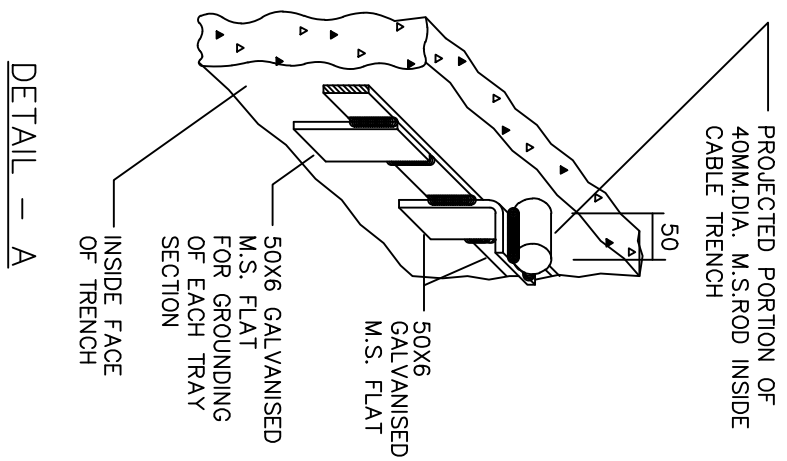
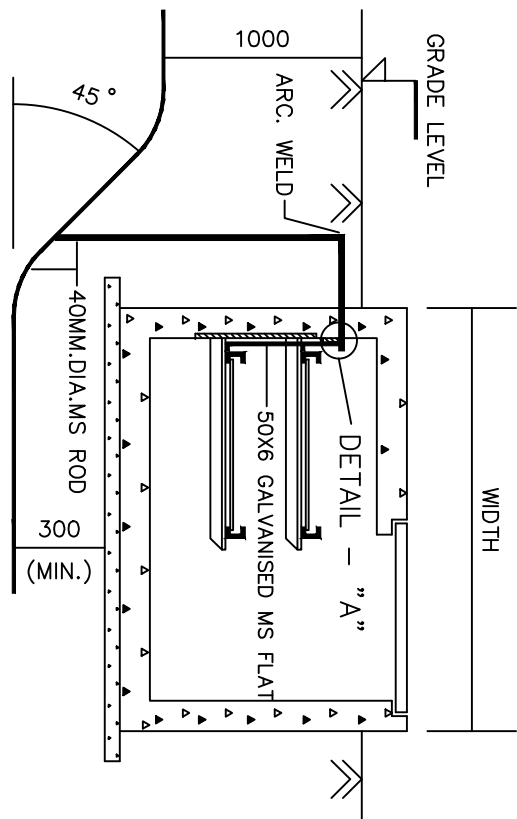
GROUNDING OF MCC, SWITCHGEAR

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				 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
GROUNDING				JOB NO. 18A09 SCALE : NTS			
NOTES & DETAILS							
2X500MW THERMAL POWER PLANT AT TUTICORIN				DWG. NO. 18A09-DWG-E-0600 SH. 20 OF 26			
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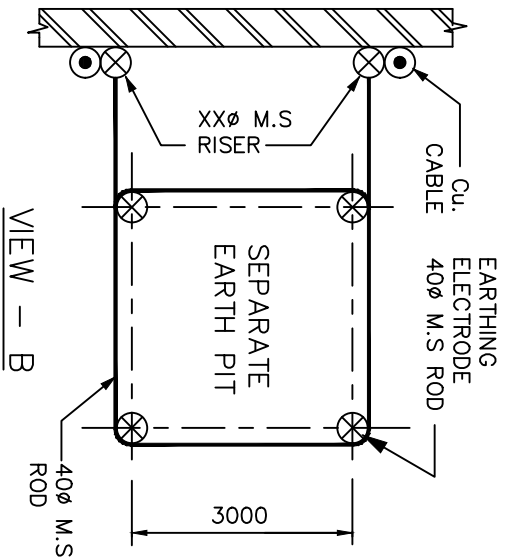
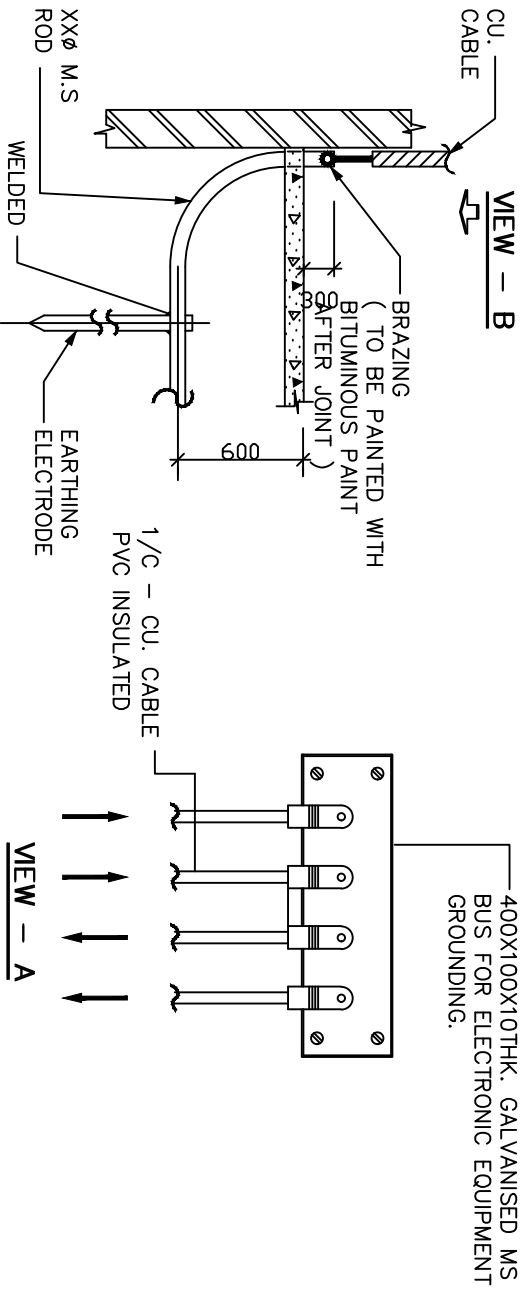
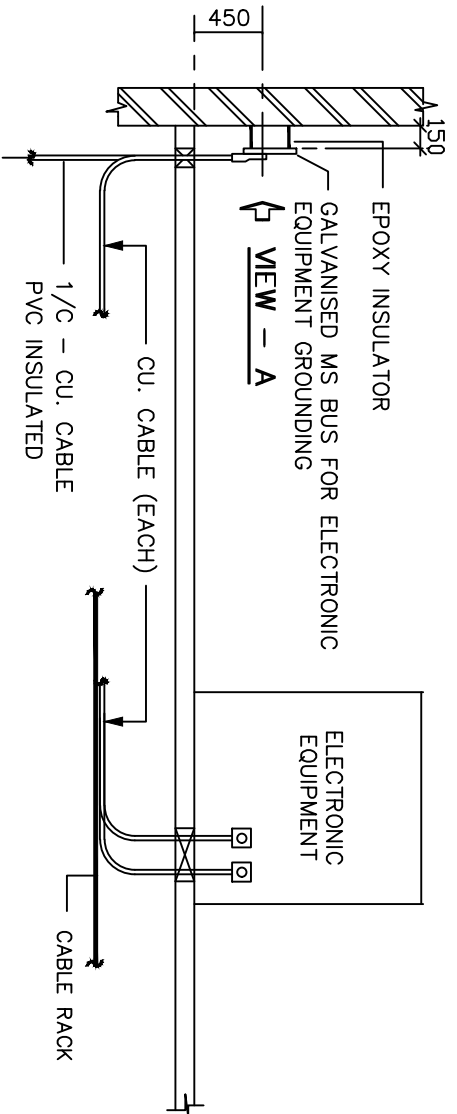
**OVERHEAD CABLE TRAY
GROUNDING**



**CABLE TRENCH
GROUNDING**

FOR TENDER PURPOSE ONLY

				 GROUNDING NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0600	
DS	SM	BG	-	12.02.19	SCALE :	NTS	REV.
APPVD.	REVMD.	CHKD.	REV.	DATE			

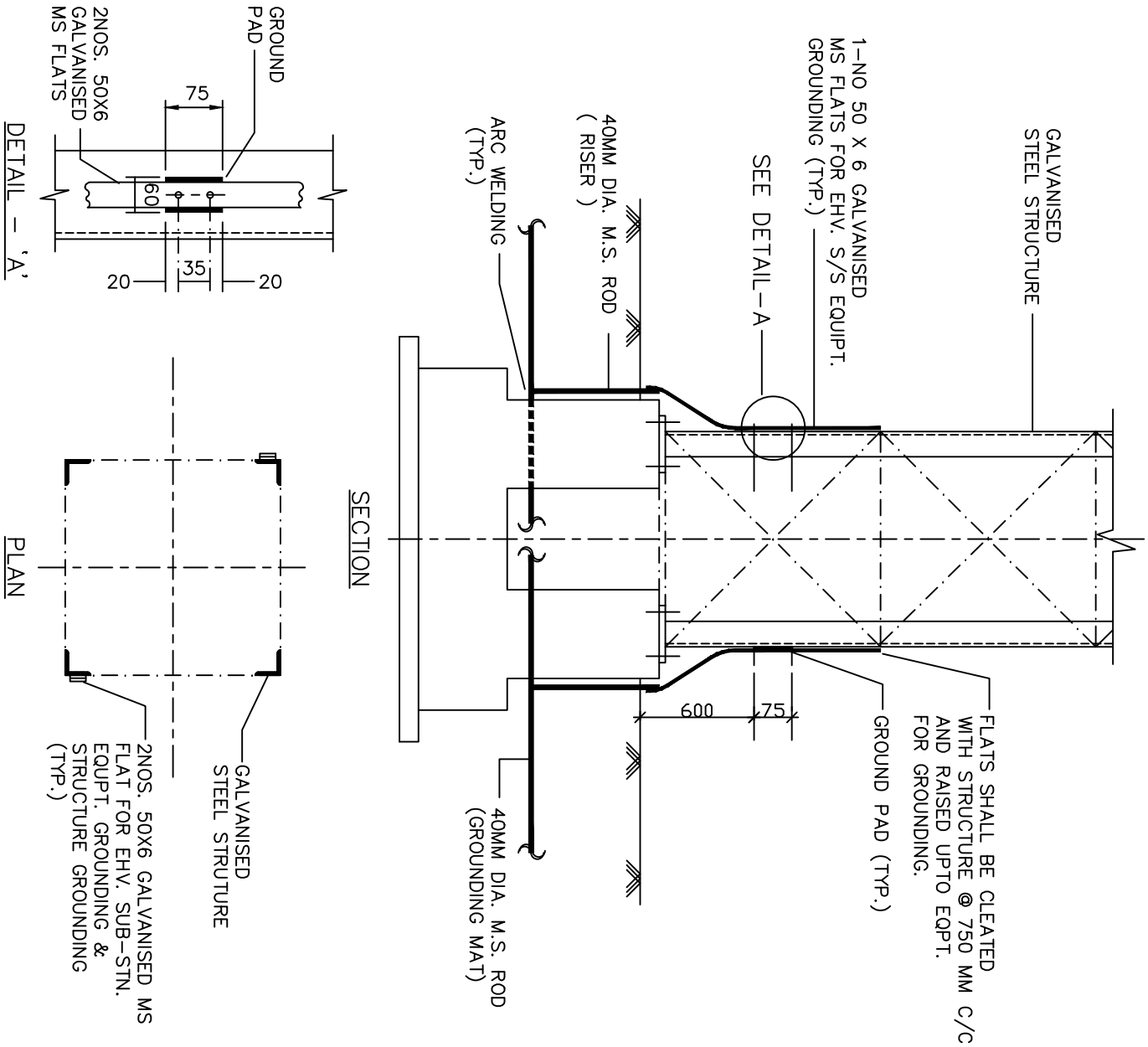


- NOTES :**
1. GALVANISED MS BUS SHALL BE MOUNTED ON INSULATOR BASE AT TWO SUITABLE LOCATIONS.
 2. EACH ELECTRONIC EQUIPMENT/PANEL GROUND TERMINAL SHALL BE CONNECTED TO THE BUS BY MEANS OF CU. CABLE.
 3. GROUND BUS SHALL IN TURN BE CONNECTED BY MEANS OF 2-1/C PVC INSULATED CU. CABLE TO SEPARATE EARTH PIT AT SUITABLE LOCATION.

ELECTRONIC EQUIPMENT GROUNDING.



FOR TENDER PURPOSE ONLY

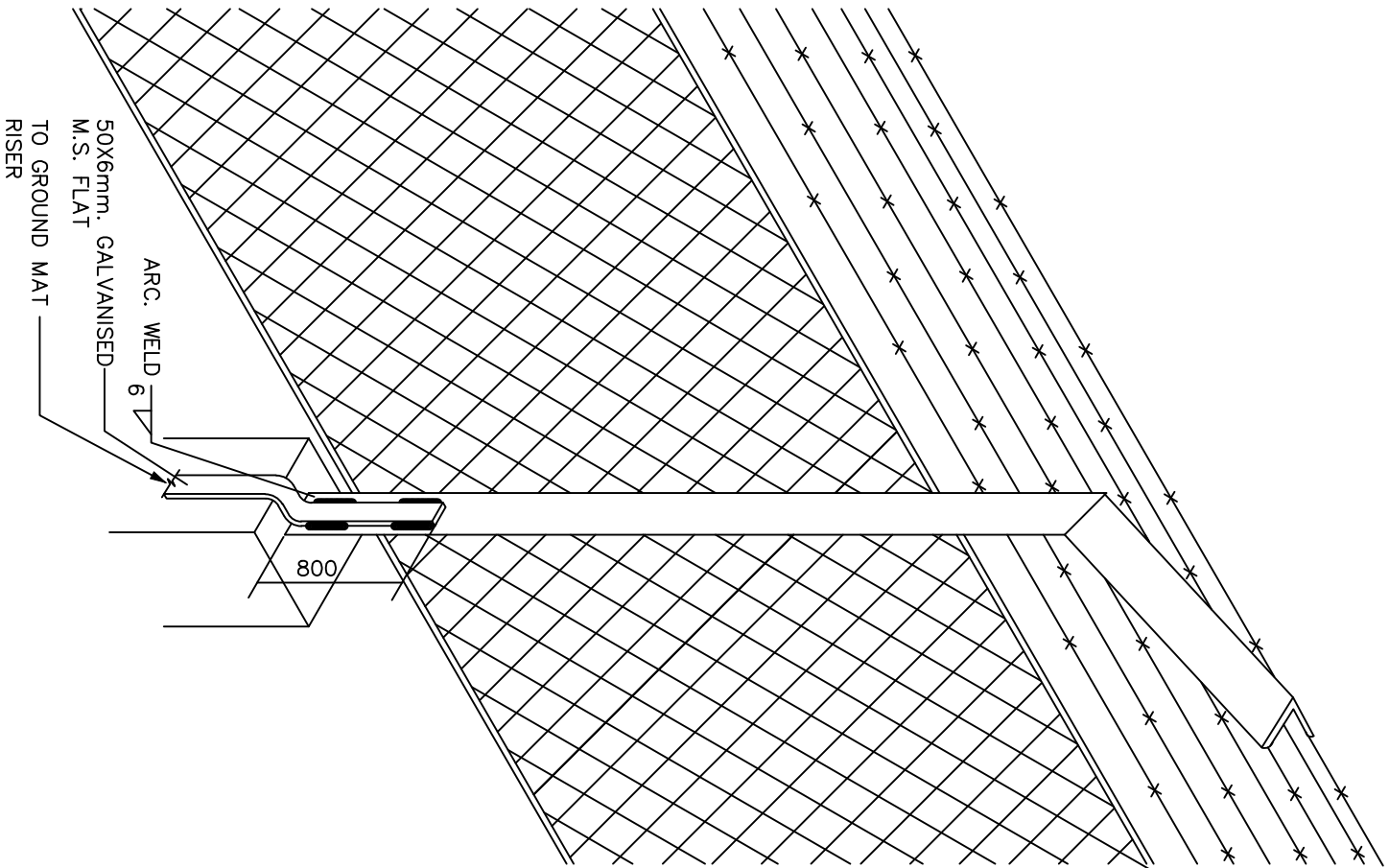
				GROUNDING NOTES & DETAILS				DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
DS	SM	BG	-	12.02.19	NLC TAMILNADU POWER LIMITED				JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0600		SHT. 22 OF 26	REV.



GALVANISED STRUCTURE AND EQUIPMENT GROUNDING



FOR TENDER PURPOSE ONLY

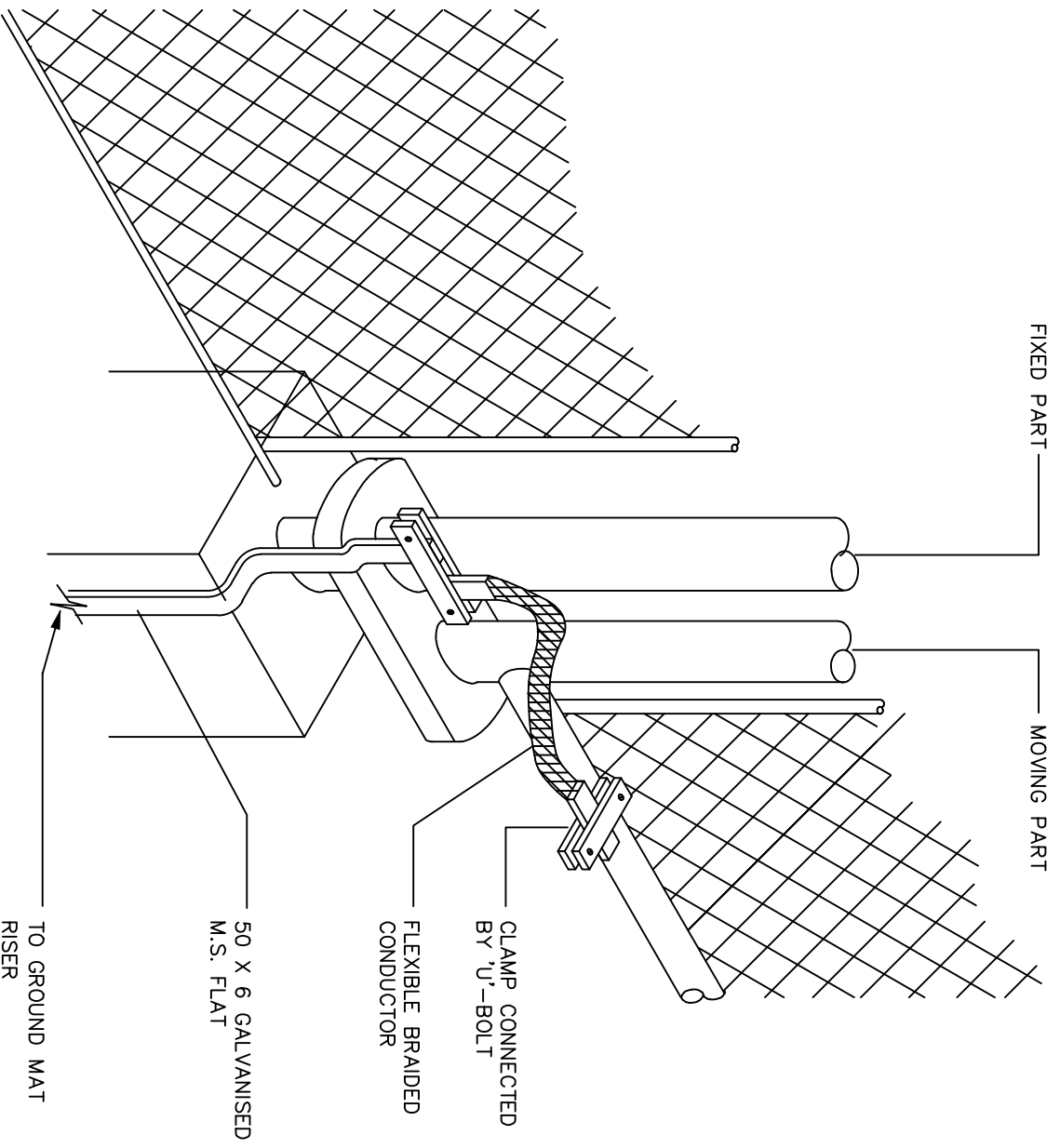
GROUNDING NOTES & DETAILS				 NLC TAMILNADU POWER LIMITED			
2X500MW THERMAL POWER PLANT AT TUTICORIN				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
APPVD.	REVMD.	CHKD.	REV.	DATE	JOB NO.	SCALE :	REV.
SM	BG	-	-	12.02.19	18A09	NTS	-
					DWG. NO. 18A09-DWG-E-0600	SHT. 23 OF 26	



FENCE GROUNDING



FOR TENDER PURPOSE ONLY

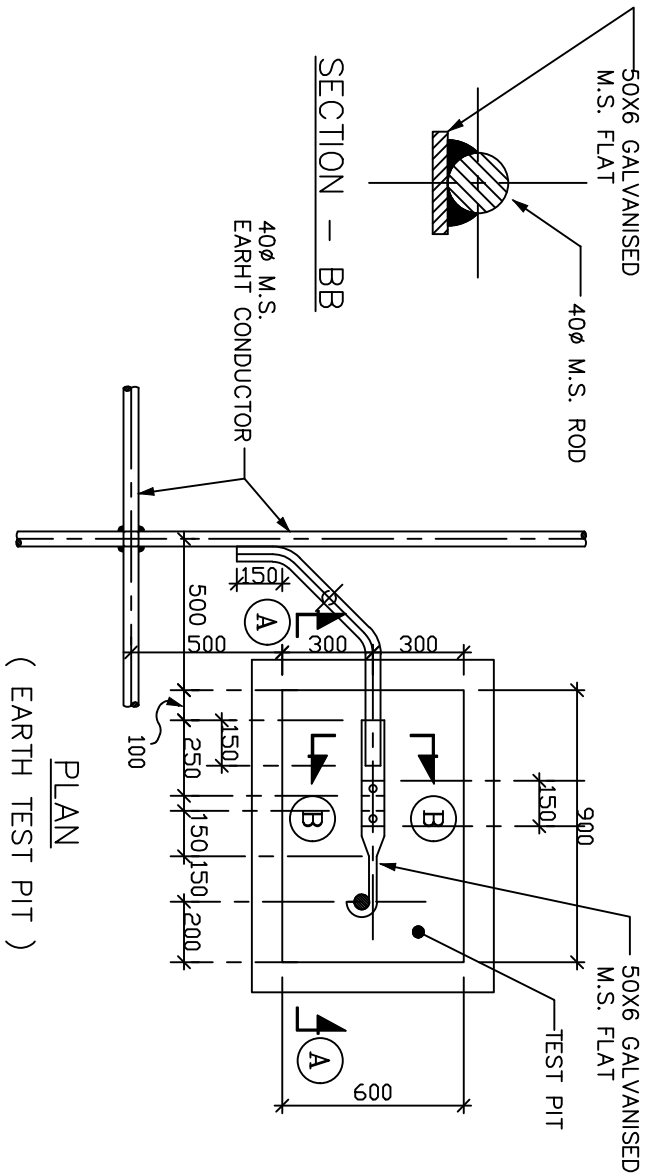
						GROUNDING NOTES & DETAILS			
				NLC TAMILNADU POWER LIMITED		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
				2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO. 18A09		SCALE : NTS	
APPVD.	REVMD.	CHKD.	REV.	DATE	DWG. NO. 18A09-DWG-E-0600 SHT. 24 OF 26		REV.		
DS	SM	BG	-	12.02.19					



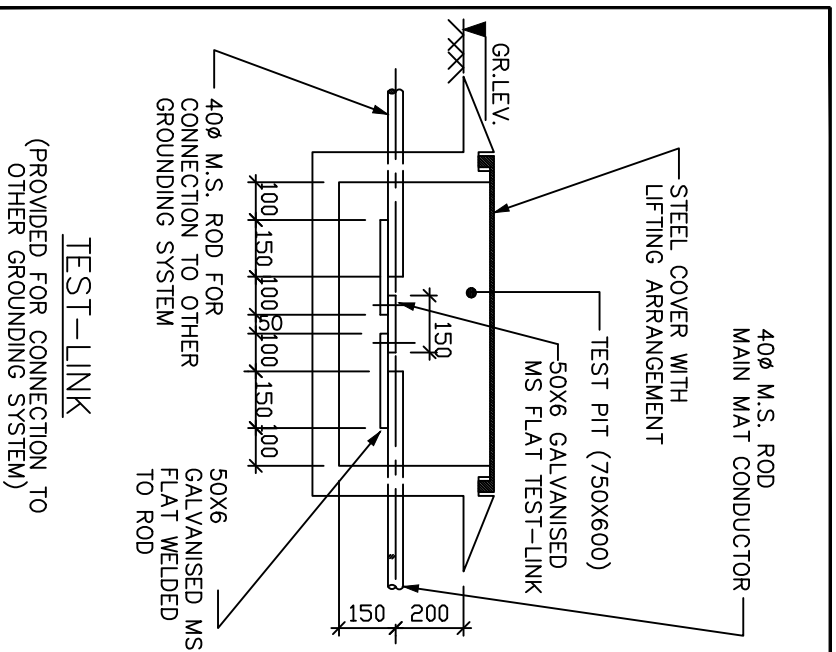
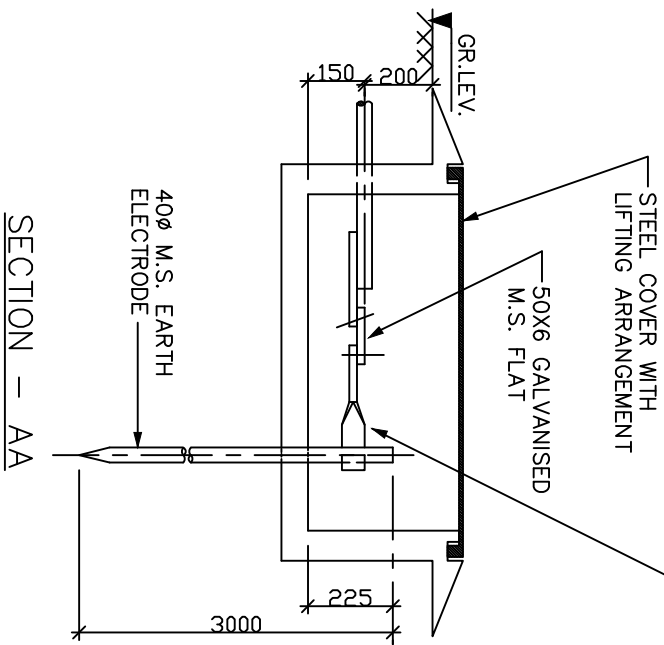
FENCE GATE GROUNDING

FOR TENDER PURPOSE ONLY


 GROUNDING NOTES & DETAILS			 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
NLC TAMILNADU POWER LIMITED			JOB NO. 18A09		
2X500MW THERMAL POWER PLANT AT TUTICORIN			SCALE : NTS		
DS SM BG - 12.02.19			DWG. NO. 18A09-DWG-E-0600		
APPVD. REVMD. CHKD. REV. DATE			SHT. 25 OF 26		
			REV. -		



50X6 GALVANISED M.S. FLAT TWISTED AT 90° BY GAS HEATING AND WELDED TO ELECTRODE ON TOP AND BOTTOM ALL AROUND BEFORE ELECTRODE IS DRIVEN INTO THE EARTH



FOR TENDER PURPOSE ONLY

GROUNDING NOTES & DETAILS				 NLC TAMILNADU POWER LIMITED DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
APPVD.	REVMD.	CHKD.	REV.	DATE	JOB NO.	SCALE :	REV.
DS	SM	BG	-	12.02.19	18A09	NTS	-
2X500MW THERMAL POWER PLANT AT TUTICORIN				DWG. NO. 18A09-DWG-E-0600 SH. 26 OF 26			




ILLUMINATION
NOTES & DETAILS

DWG. NO. 18A09-DWG-E-0800

FOR TENDER PURPOSE ONLY

1. The notes define some areas of responsibility and construction practices to be used. The symbols are used to save notes and space in generating and interpreting the drawings. The details provide typical examples of lighting installations. The words lighting fixture and receptacles used in this document is synonymous to luminaire and sockets.
The installation / support details shown are typical installation details. The Contractor is responsible for the structural adequacy of the installation.
2. These lighting notes and details shall be read and construed in conjunction with the Illumination Layout and drawings.
3. Except specifically approved by site office, installation of exposed conduits, mounting of lighting fixtures etc. shall be taken up only after all other services such as Piping, Air Ducting, Cable Tray/Busduct Hanger, Structural Bracings etc. in a particular area have been installed.
4. The Contractor shall develop final conduit/cable routing based on fixture location and other site conditions.
5. Unless otherwise shown, the mounting heights of lighting fixtures and accessories shall be generally as follows :
 - a) i) Low-Bay Lighting Fixtures : upto 3500 mm from bottom in general indoor Areas of Industrial plants.
 - ii) Medium Bay Type Fixtures. : above 3500 mm from bottom
 - b) Bracket lights over door Openings : 300 mm bottom of Fixture Above top of opening
 - d) Receptacles -
 - i) In control room/office : 300 mm from finished floor
 - ii) Elsewhere : 1000 mm from finished floor
 - e) Local Switches : 1500 mm from finished floor
 - f) Lighting Panels : 1200 mm from finished floor
6. All lighting fixtures shall be fed from respective lighting panel. Normal AC lighting will be fed from normal lighting panel. Emergency AC lighting panel which in-turn connected with UPS.
7. Switchboard shall be used in office area. Separate switchboard has been considered for normal & emergency supply.

FOR TENDER PURPOSE ONLY

						 ILLUMINATION NOTES & DETAILS	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
						 NLC TAMILNADU POWER LIMITED	JOB NO. 18A09 SCALE : NTS	
DS	SM	BG	-	12.02.19		2X500MW THERMAL POWER PLANT AT TUTICORIN	DWG. NO. 18A09-DWG-E-0800 SHT. 01 OF 25	REV. -
APPVD.	REVWD.	CHKD.	REV.	DATE				-

8. All lighting fixtures shall generally have LED type luminaires (colour temperature 4000k) unless otherwise noted. The type of fixture in different areas are as follows. Cable shall be normally laid in cable tray in main building. conduit wiring system shall be used for staircase, battery room etc.



Type	Philips LED option/Equivalent	Location
LA	Endural LED - Bulkhead luminaire WT 202W LED 6S CW PSU SI PC or Equivalent	Staircase
LT	Green Perform LED Batten BN 208C LED 40/DL LI 200 FR or Equivalent	Switchgear room, Electrical/Mechanical shop
LW	Waterproof IP65 Batten luminaire TCW 450 with 2x20W LED tube 1200mm 20W 840 T8 IND I or Equivalent	Battery room
LG	Energy efficient recess mounted LED luminaire suitable for 2x2 grid Cirrus RC 365B LED22 4000 PSU OD WH or Equivalent	Office, Electrical room with false ceiling
LM	Medium and high bay luminaire Green bay LED BY 400V LED 1355 CW SK PSU SI FGWH or Equivalent	TG hall, Operating floor
LD	Recess mounted LED down light for spot option Green LED DNI94B LED15S-4000 PSU WH or DNI92B LED9S-4000 PSU WH or equivalent	Control room

9. Receptacle circuits shall be kept separate and distinct from lighting circuits.
10. Lighting fixtures stems (pendants) shall be 19 mm galvanized rigid steel conduit. Recess mounted fixture shall be hanged through chain/ stem as per installation facility available for particular fixture.
11. Wires/cable shall be spliced only at junction boxes with ring-tongue lugs or approved equal.
12. For cable/wire numbering, PVC sleeve with cable/wire Tag number of different colour code shall be used.
13. All lighting fixtures, local switches and receptacle outlets shall be grounded in accordance with IS 3043, NBC & IE rule. Multicore Multicore (multi-conductor) cable shall be provided with integral ground wire. Where multicore cables are not used, each lighting/small power circuits shall carry a separate ground wire.
14. Unless otherwise noted, the minimum size of cables, conduits, junction boxes shall be as below :

A. CABLES

- i) From main lighting distribution : 1x3-1/2C, 95 Sq.mm
Boards to 415 V normal
AC lighting panels

FOR TENDER PURPOSE ONLY

					ILLUMINATION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
					 NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
					2X500MW THERMAL POWER PLANT AT TUTICORIN		SCALE : NTS	
DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-0800			REV.
APPVD.	REVWD.	CHKD.	REV.	DATE	SHT. 02 OF 25			-

- ii) From lighting panel to junction box : 1x3C, 10 Sq.mm AL XLPE
- iii) From junction box to lighting fixtures : 1x3C, 2.5 Sq.mm Cu XLPE

B. CONDUITS



- i) Conduits for lighting fixtures and receptacles will not be shown on the lighting drawings. It is the responsibility of Contractor to detail the raceway system as required for the circuits shown on the lighting layouts and panel board/lighting schedules.
- ii) Exposed conduit shall be installed either perpendicular or parallel to adjacent structural steel in a workmanlike manner.
- iii) Galvanized flexible metallic conduit may be used for recessed lighting fixtures in suspended ceilings and in other dry areas subject to vibration.
- iv) Conduits shall be run at least 460mm (18") apart from flues, insulated steam pipes or hot water pipes. They shall be supported every 2450mm (8'-0"). All supporting material shall be zinc coated.
- v) Raceway system shall be complete and continuous in all respects prior to pulling any cable. All fittings, wireways and boxes shall be properly grounded and bonded.
- vi) Raceway for luminaries (lighting) and sockets (receptacles) shall be independent and separate from all other power and control raceways. No cable tray shall be used for routing of lighting or receptacle branch circuits.
- vii) All raceways shall be terminated with insulated bushings or conduit hubs.
- viii) All embedded conduit shall be HDPE or rigid galvanized steel conduit, unless otherwise noted. Conduits installed in concrete shall be a minimum of 27mm (1") in diameter.
- ix) Exposed lighting and receptacle conduit in clean, dry, areas, where the raceway will not be subjected to mechanical damage may be electrical metallic tubing (EMT). EMT fittings shall be compression type.
- x) All conduits shall be of galvanised steel of following minimum sizes :

CABLE SIZE	CONDUIT. SIZE					Maximum No. of Conductors Admissible for conduit
	21MM	27MM	35MM	41MM	53MM	
a) 10 Sq.mm AL	-	2	5	7	8	} Maximum No. of Conductors Admissible for conduit
b) 2.5 Sq.mm CU	3	5	9	-	-	

C. JUNCTION BOXES

CONDUIT SIZE (MM)	JUNCTION BOX SIZE (MM)			
	4-WAY	3-WAY	STRAIGHT THROUGH	90°
a) 21 / 27	150x150x100	150x100x100	88 Ø	88 Ø
b) 35 / 41	254x200x127	254x200x127	150x150x100	-
c) 53	254x200x127	254x200x127	254x200x127	-

FOR TENDER PURPOSE ONLY

					ILLUMINATION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
					 NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
					2X500MW THERMAL POWER PLANT AT TUTICORIN		SCALE : NTS	
DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-0800			REV.
APPVD.	REVWD.	CHKD.	REV.	DATE	SHT. 03 OF 25			-

All lighting panels/distribution boards, junction boxes, receptacles, Fixtures, Conduits, etc. shall be grounded in compliance with the provision of I.E. rule and as detailed below :

- a) Lighting Panels : 25 x 3 MM G.S. Flat
- b) Distribution Boards : 50 x 6 MM G.S. Flat
- c) Power Receptacles, Junction Boxes etc : Third core of the three core cable
- d) Lighting fixtures, switches, conduits etc. : Third core of the three core cable



D. RECEPTACLES

- i) Receptacles shall be 16A, 240VAC single phase duplex type with earth (ground) and fed from 240V lighting/receptacle distribution boards.
- ii) Sockets (receptacles) should be located in convenient locations and spaced to provide access to any point with a 25 meters (85'-0") extension cord.

E. LOCAL SWITCHES

- i) Each local switch, light fixture, wall receptacle and other misc. devices in an office or room with hollow partitioned walls shall be flush mounted in a galvanized pressed steel outlet box of the knockout type of not less than 1.830 mm thick.
 - ii) Local switches, light fixture, wall receptacles and other misc. devices in all other indoor locations shall be surface mounted in cast hub box (FD Cast Device Box or equal) with sheet steel covers.
 - iii) Local switches, light fixtures, receptacles and other misc. devices in hazardous areas, corrosive areas or areas exposed to the weather shall be surface mounted in outlet boxes with covers approved for the particular conditions involved.
 - iv) Motion controlled light sensors shall be provided in hallways and conference rooms to enable switching off lights when not required.
 - v) Light switches shall be placed at the entry point of rooms. Where there are two entry points to a room, three way switches shall be employed. When there are three or more entry points to a room, four way switches shall be employed. If three or four way switches has current limitations for controlling the number of lighting fixtures, local switch with auxiliary relay and contactor shall be used for controlling the lighting fixtures.
 - vi) Switches controlling light fixtures and exhaust fans of battery room shall be located outside of the battery room.
15. The electrical installation work shall met the requirements of Indian Electricity Rules, relevant IS codes of practice and safety codes, all as ammended upto date. In addition, other rules or regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.
16. Typical details of lighting fixtures, other lighting system components and their mounting arrangement as shown herein are for general guidance only, The type no. of some make has been referred in the various drawings. Only to indicate desired appearance, construction features and performance of the fixture. The contractor has to design the same fulfilling the requirement of the specification.

FOR TENDER PURPOSE ONLY

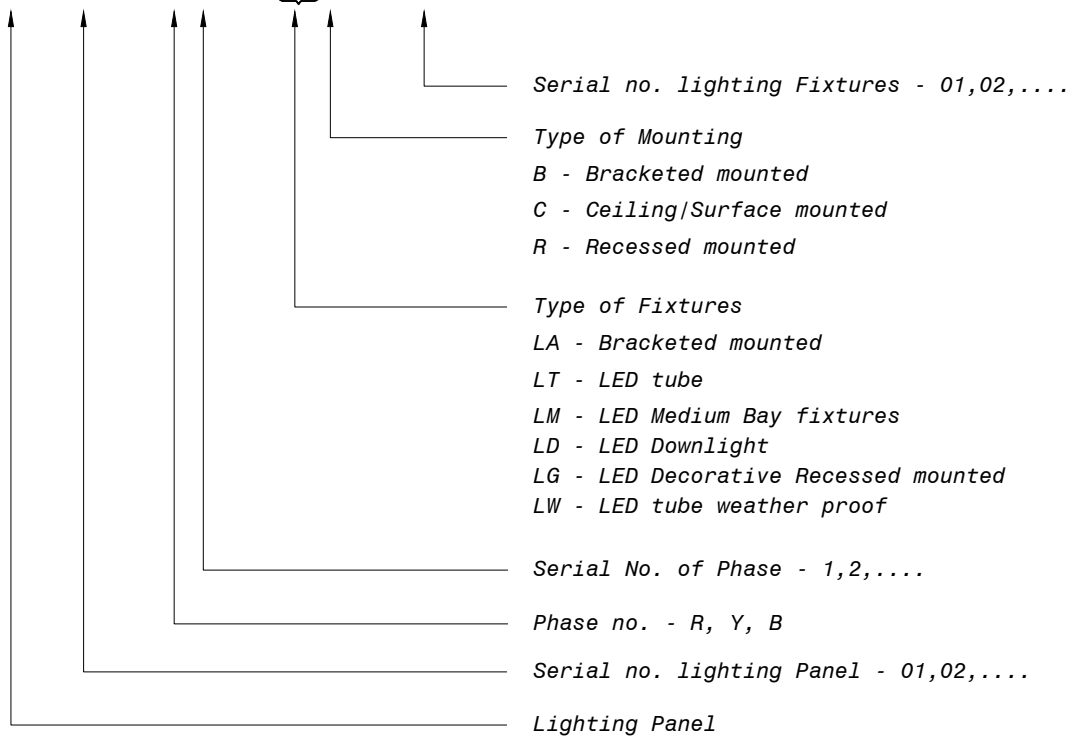
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					 NLC TAMILNADU POWER LIMITED	JOB NO. 18A09 SCALE : NTS	
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN	DWG. NO. 18A09-DWG-E-0800 SHT. 04 OF 25	
APPVD.	REVWD.	CHKD.	REV.	DATE		REV.	-

18A09-DWG-E-0800 Sh. 04 OF 25 12.02.2019



A4_DD (9-96) [210x297]

17. Lightnig fixtures numbering system is as follows :

XXX-XX - YY - UUV - MM

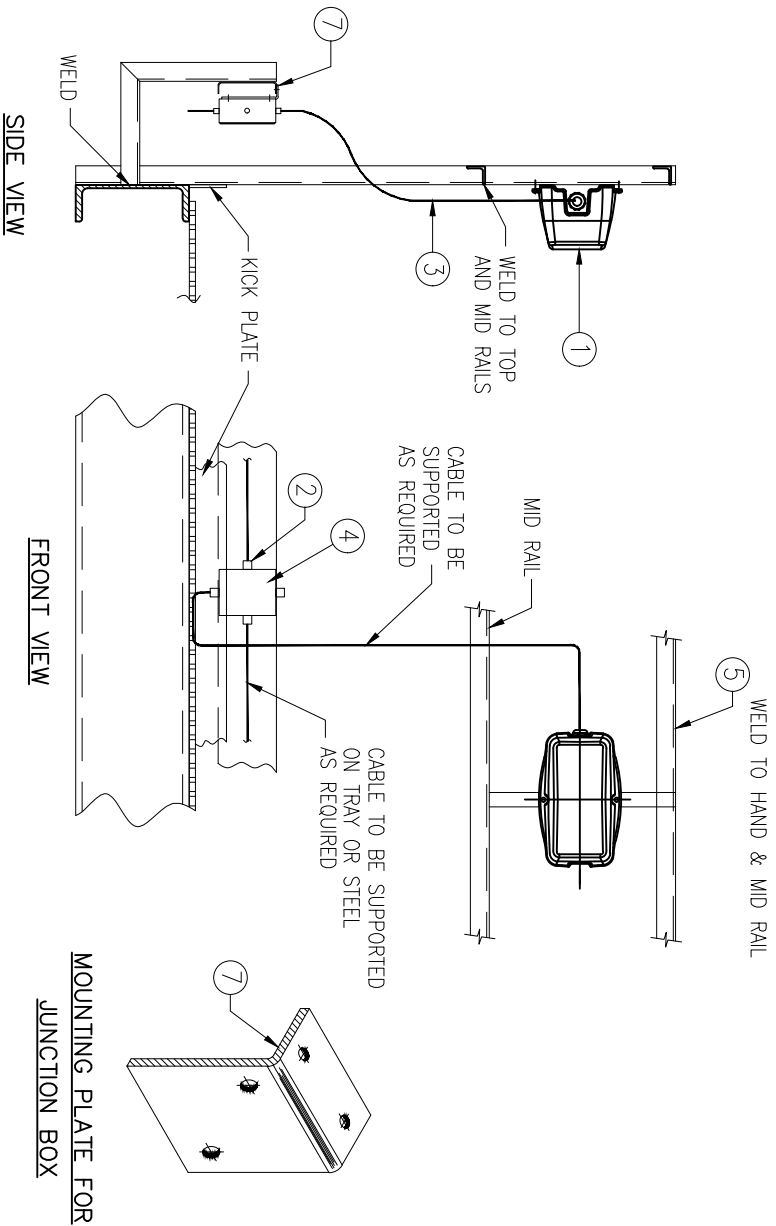


FOR TENDER PURPOSE ONLY

					ILLUMINATION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
					 NLC TAMILNADU POWER LIMITED		JOB NO. 18A09 SCALE : NTS	
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0800 SHT. 05 OF 25	
APPVD.	REVWD.	CHKD.	REV.	DATE			REV. -	

18A09-DWG-E-0800 Sh. 05 OF 25 12.02.2019

A4_DD (9-96) [210x297]





ITEM NO.	DESCRIPTION	QTY.
1	LED LUMINAIRE-WT202W LED65 CW PSU SI PC OR EQUIVALENT.	1 NO.
2	CABLE GLAND FOR ITEM 3	AS REQUIRED
3	30x2.5mm ² XLPE, SWA CABLE	AS REQUIRED
4	JUNCTION BOX	1 NO.
5	50x6mm MILD STEEL FLAT BAR	AS REQUIRED
6	M6x25mm Lg. MILD STEEL BOLT PLATED C/W NUT AND WASHER	AS REQUIRED
7	3mm THK. MILD STEEL PLATE	AS REQUIRED

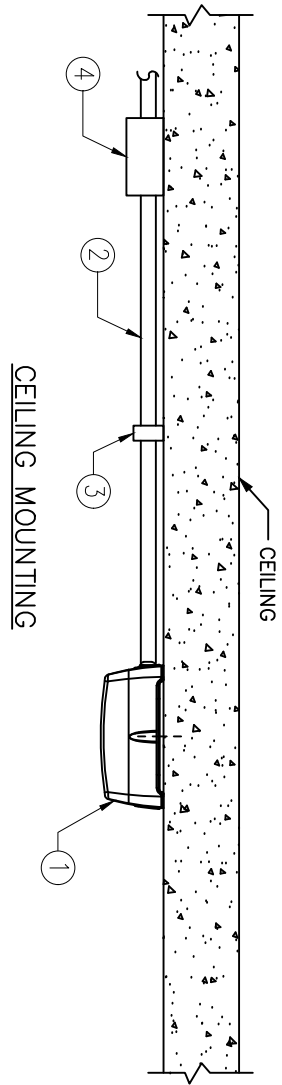
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS (mm)
2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANIZED OR ZINC PASSIVATED
3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED
4. AFTER DRILLING, THE CHANNEL IS TO BE PREPARED, PRIMED AND PAINTED.

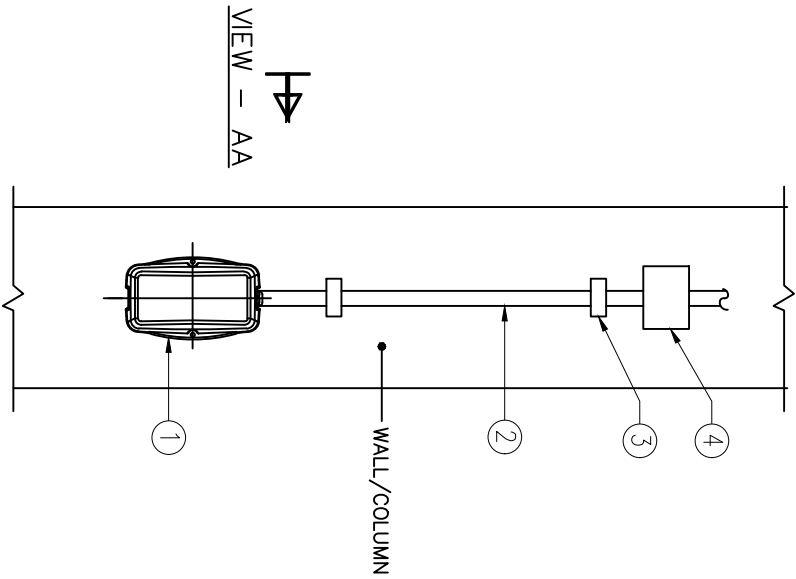
HORIZONTAL LED LUMINAIRE (TYPE-LA)
HANDRAIL MOUNTED

ILLUMINATION NOTES & DETAILS				 NLC TAMILNADU POWER LIMITED			
2X500MW THERMAL POWER PLANT AT TUTICORIN				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
APPVD.	REVWD.	CHKD.	REV.	DATE	JOB NO.	SCALE :	REV.
DS	SM	BG	-	12.02.19	18A09	NTS	-
					DWG. NO. 18A09-DWG-E-0800	SHT. 06 OF 25	

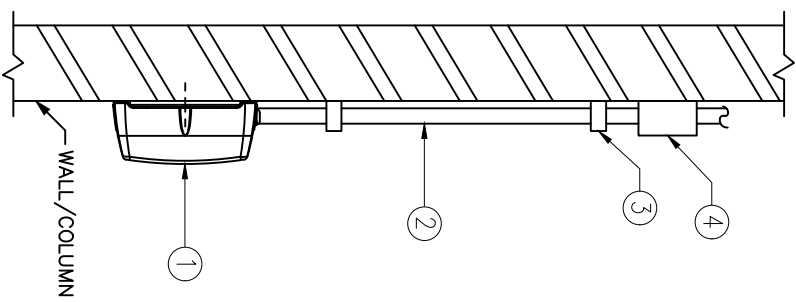
FOR TENDER PURPOSE ONLY



CEILING MOUNTING



WALL/COLUMN MOUNTING





VIEW - AA

**BULKHEAD LUMINAIRE WALL/COLUMN/CEILING MOUNTED, TYPE-LA
(FOR STAIR CASE ONLY)**

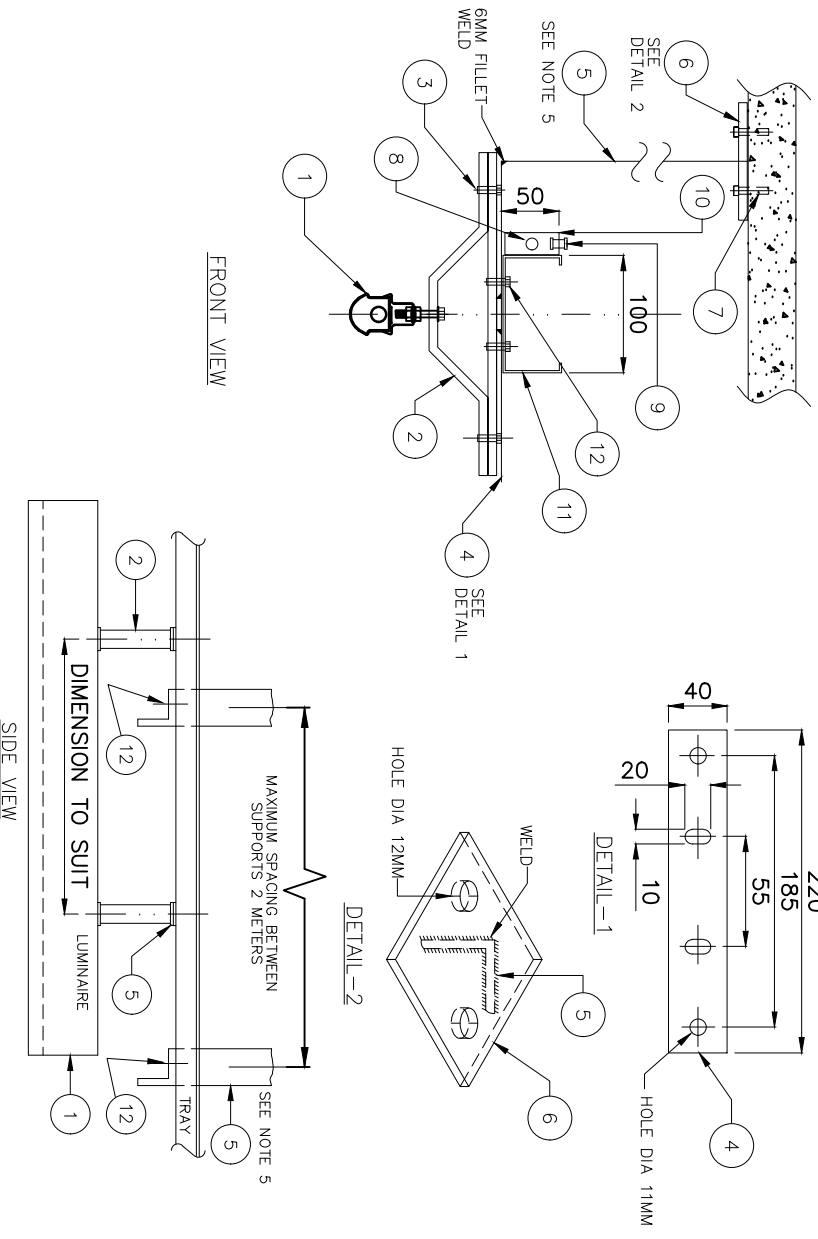
ITEM NO.	DESCRIPTION	QTY.
1	LED LUMINAIRE-W1202W LED65 CW PSU SI PC OR EQUIVALENT.	1 NO.
2	20ø CONDUIT	AS REQUIRED
3	SADDLE	AS REQUIRED
4	JUNCTION BOX	1 NO.

- NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETERS (mm)
 2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANIZED OR ZINC PASSIVATED
 3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED
 4. AFTER DRILLING, THE CHANNEL IS TO BE PREPARED, PRIMED AND PAINTED.

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS				 NLC TAMILNADU POWER LIMITED				
2X500MW THERMAL POWER PLANT AT TUTICORIN				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS				
DS	SM	BG	-	12.02.19	JOB NO.	18A09	SCALE :	NTS
APPVD.	REVMD.	CHKD.	REV.	DATE	DWG. NO.	18A09-DWG-E-0800	SHT. 07 OF 25	REV.

ELECTRICAL INSTALLATION OF STANDARD FLOURESCENT LUMINAIRE MOUNTED ON TRAY, 2x40W, GREEN PERFORM BATTEN LED OR EQUIVALENT IP31, TYPE LT



ITEM No.	DESCRIPTION	QUANTITY
1	FLOURESCENT LUMINAIRE – 2x40W, BN 208C LED 40/DL LI 200 FR OR EQUIVALENT	1 EACH
2	CEILING BRACKET	2 EACH
3	M10x20mm LONG NUT, BOLT AND WASHER	5 EACH
4	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	2 EACH
5	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
6	100x100x6mm THK. MILD STEEL PLATE, GALVANISED	1 EACH
7	STOM RED HEAD ANCHOR AND BOLTS	2 EACH
8	CABLE – 1.1KV/ 3 CORE x 2.5sq:mm CU SWA CABLE	1 METER
9	GLAND – INDUSTRIAL, IP55 (FOR ITEM 9)	2 EACH
10	JUNCTION BOX – INDUSTRIAL IP55	1 EACH
11	CABLE TRAY – 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
12	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	AS REQUIRED

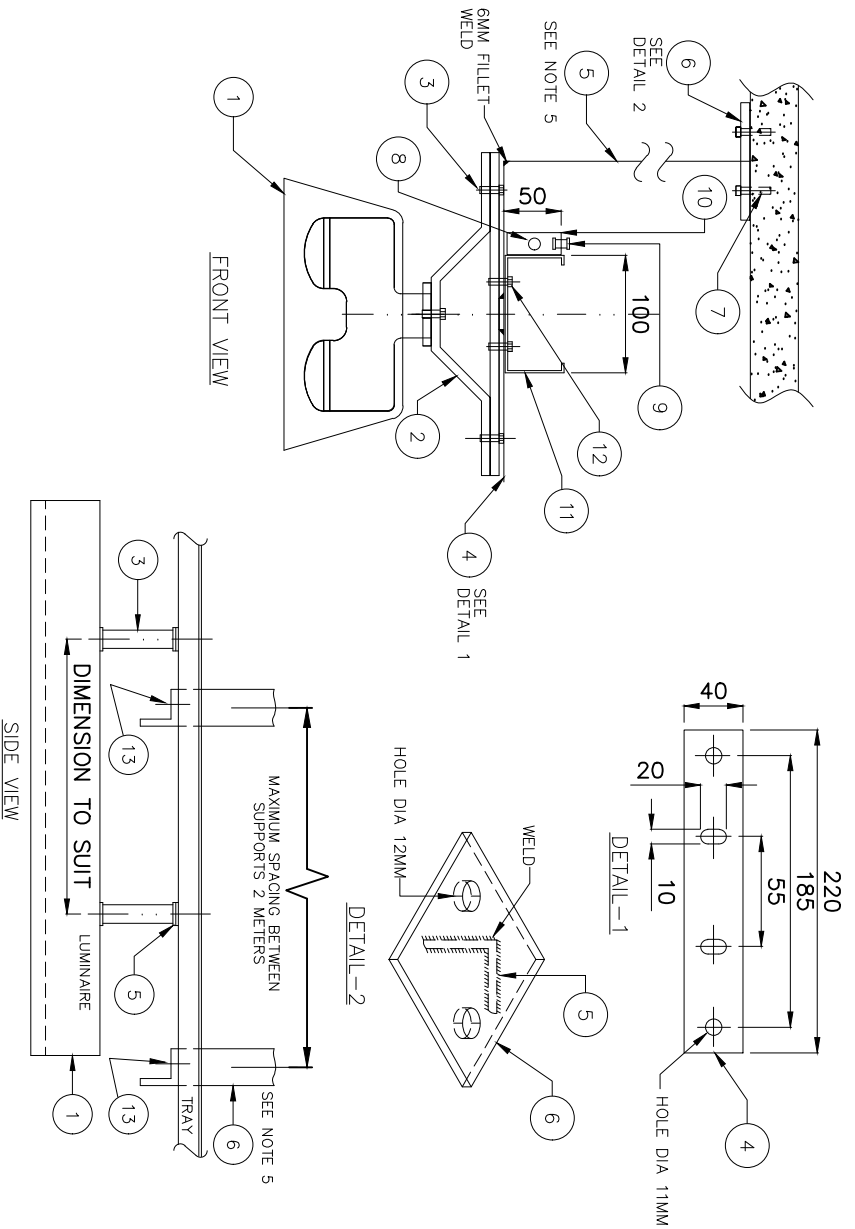
NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PLATED.
3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
4. ALL DAMAGE TO GALVANISED FINISHES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
5. THE LENGTH OF SUPPORT SHALL BE ADJUSTED TO MAINTAIN THE REQUIRED ELEVATION MARKED IN LIGHTING LAYOUT.
6. THE LOCATION AND SIZE OF JUNCTION BOX IS INDICATIVE ONLY. FIELD ENGINEER MAY LOCATE AS PER SITE CONDITION.

FOR TENDER PURPOSE ONLY

APPVD.		REVMD.	CHKD.	REV.	DATE	 ILLUMINATION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19		NLC TAMILNADU POWER LIMITED 2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO. 18A09 SCALE : NTS DWG. NO. 18A09-DWG-E-0800 REV. - SH. 08 OF 25	

ELECTRICAL INSTALLATION OF LED TUBE (WEATHER PROOF) LUMINAIRE MOUNTED ON TRAY, 2x20W, TCW 450 LED OR EQUIVALENT IP65, TYPE LW



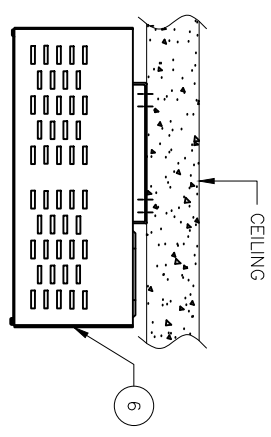
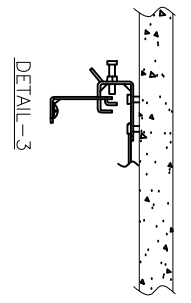
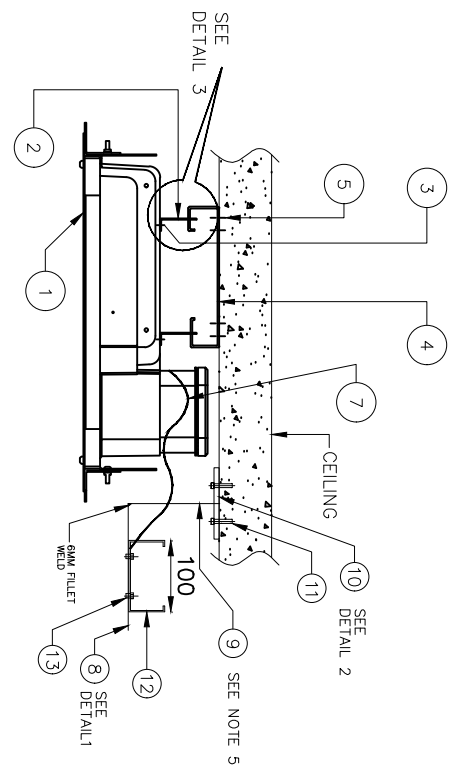
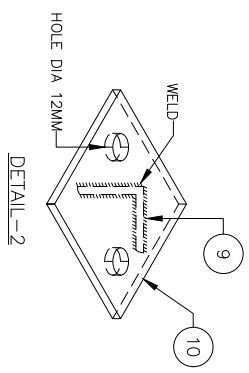
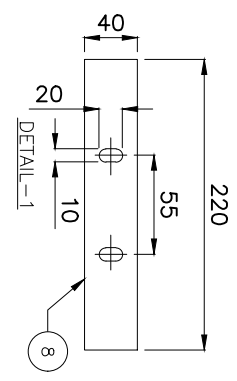
ITEM No.	DESCRIPTION	QUANTITY
1	FLUORESCENT LUMINAIRE - 2x20W LED TUBE 20W 840 T8 INDI OR EQUIVALENT IN TCW 450 OR EQUIVALENT	1 EACH
2	CEILING BRACKET	2 EACH
3	M10x200mm LONG NUT, BOLT AND WASHER	5 EACH
4	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	2 EACH
5	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
6	100x100x6mm THK. MILD STEEL PLATE, GALVANISED	1 EACH
7	STOW RED HEAD ANCHOR AND BOLTS	2 EACH
8	CABLE - 11KV 3 CORE x 2.5sq. mm CU SWA CABLE	1 METER
9	GLAND - INDUSTRIAL, IP65 (FOR ITEM 9)	2 EACH
10	JUNCTION BOX - INDUSTRIAL, IP65	1 EACH
11	CABLE TRAY - 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
12	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	AS REQUIRED

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PLATED.
3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
4. ALL DAMAGE TO GALVANISED FINISHES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
5. THE LENGTH OF SUPPORT SHALL BE ADJUSTED TO MAINTAIN THE REQUIRED ELEVATION MARKED IN LIGHTING LAYOUT.
6. THE LOCATION AND SIZE OF JUNCTION BOX IS INDICATIVE ONLY. FIELD ENGINEER MAY LOCATE AS PER SITE CONDITION.

FOR TENDER PURPOSE ONLY

				 ILLUMINATION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN		
DS	SM	BG	-	12.02.19			
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				SCALE : NTS		DWG. NO. 18A09-DWG-E-0800	
				REV.		SH. 09 OF 25	



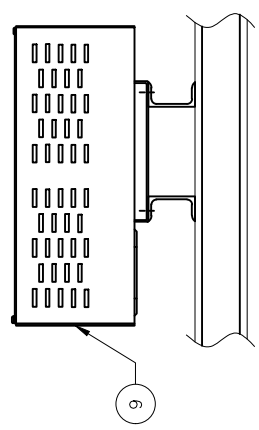
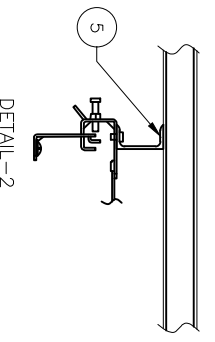
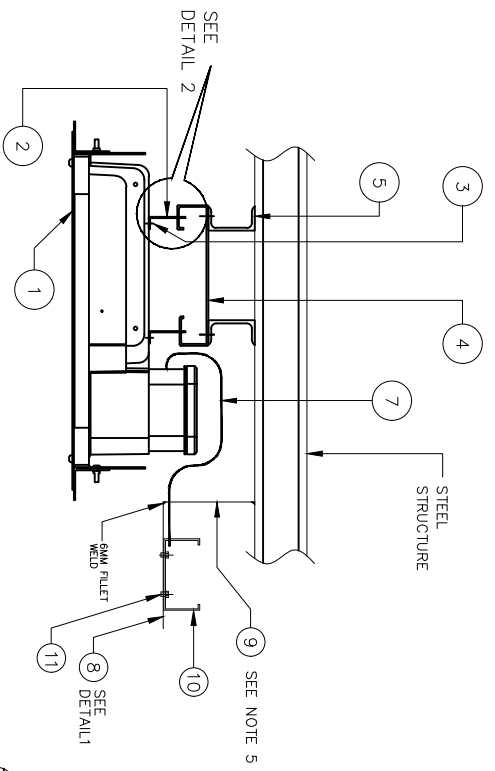
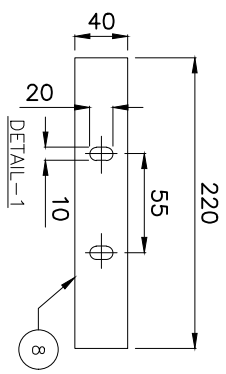
ELECTRICAL INSTALLATION OF SURFACE MOUNTED GREEN
BAY 165W OR EQUIVALENT LUMINAIRE FROM CEILING, TYPE LM

ITEM No.	DESCRIPTION	QUANTITY
1	MEDIUM OR HIGHBAY LUMINAIRE GREENBAY LED 135S CW SK PSU SI FGWH OR EQUIVALENT	1 NO.
2	LUM BRACKET	2 NOS.
3	M5 SCREW	4 NOS.
4	CEILING BRACKET	1 NO.
5	M6 SCREW	6 NOS.
6	JACKET	1 NO.
7	CABLE – 1.1KV 3 CORE x 2.5sq.mm CU SWA CABLE	1 METER
8	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	1 EACH
9	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
10	100x100x6mm THK. MILD STEEL PLATE, GALVANISED	1 EACH
11	STOM RED HEAD ANCHOR AND BOLTS	2 EACH
12	CABLE TRAY – 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
13	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	2 EACH

- NOTES :-
1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
 2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PLATED.
 3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
 4. ALL DAMAGE TO GALVANISED FINISHES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS			NLC TAMILNADU POWER LIMITED			
2X500MW THERMAL POWER PLANT AT TUTICORIN			DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
DS	SM	BC	-	12.02.19	JOB NO. 18A09	SCALE : NTS
APPVD.	REWD.	CHKD.	REV.	DATE	DWG. NO. 18A09-DWG-E-0800	REV.
					SHT. 10 OF 25	





**ELECTRICAL INSTALLATION OF SURFACE MOUNTED GREEN BAY
165W OR EQUIVALENT LUMINAIRE FROM STEEL STRUCTURE, TYPE LM**

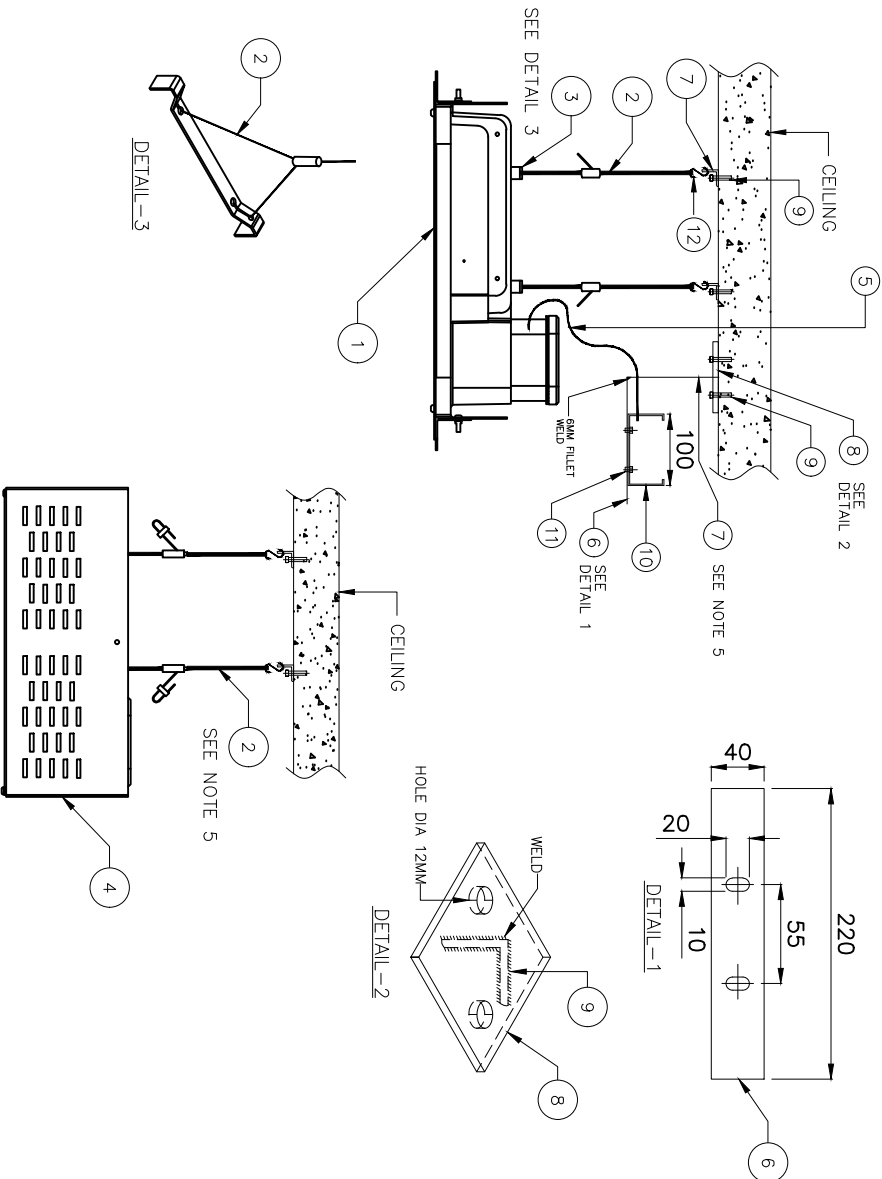
ITEM No.	DESCRIPTION	QUANTITY
1	MEDIUM OR HIGHBAY LUMINAIRE GREENBAY LED 135S CW SK PSU SI FGWH OR EQUIVALENT	1 NO.
2	LUM. BRACKET	2 NOS.
3	M5 SCREW	4 NOS.
4	CEILING BRACKET	1 NO.
5	ISMC 100	AS REQUIRED
6	JACKET	1 NO.
7	CABLE - 1.1IV 3 CORE x 2.5sq.mm CU SWA CABLE	1 METER
8	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	1 EACH
9	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
10	CABLE TRAY - 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
11	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	2 EACH

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PLATED.
3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
4. ALL DAMAGE TO GALVANISED FINISHES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS		 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09 SCALE : NTS		
DWG. NO. 18A09-DWG-E-0800			SHT. 11 OF 25		
			REV. -		



**ELECTRICAL INSTALLATION OF SUSPENDED GREEN BAY 165W
OR EQUIVALENT LUMINAIRE, TYPE LM**

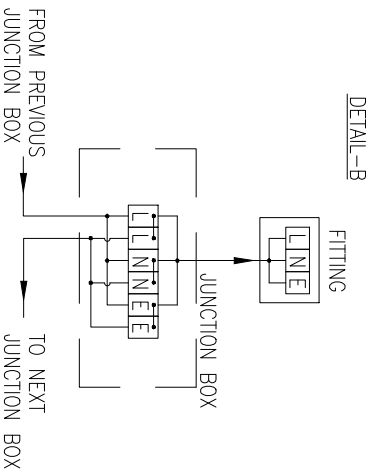
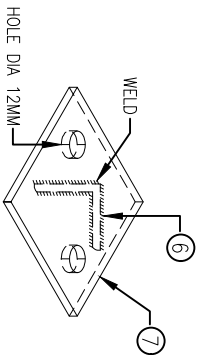
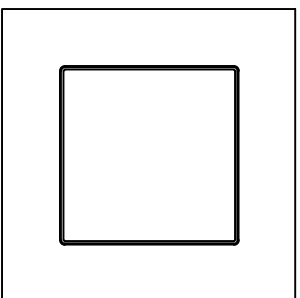
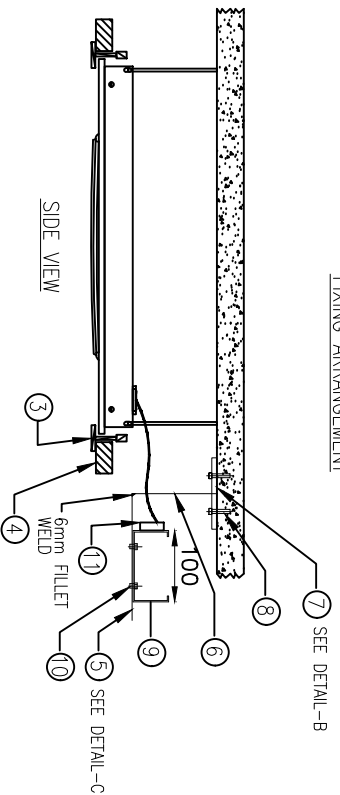
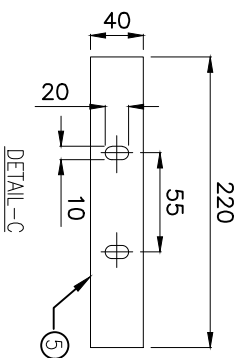
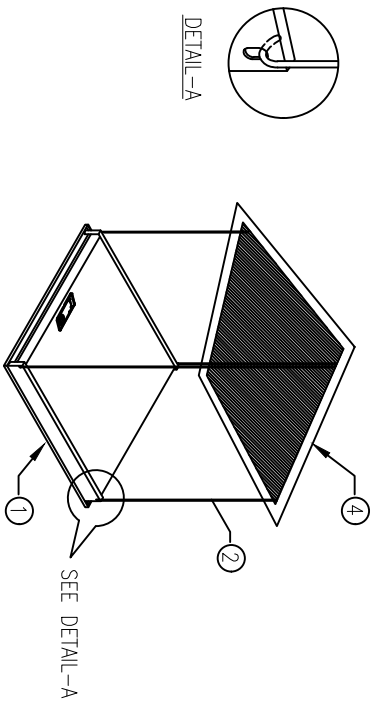
ITEM No.	DESCRIPTION	QUANTITY
1	MEDIUM OR HIGHBAY LUMINAIRE GREENBAY LED 135S CW SK PSU SI FGWH OR EQUIVALENT	1 NO.
2	CLUTCH WIRE	AS REQUIRED
3	BRACKET	2 NOS.
4	JACKET	1 NO.
5	CABLE – 1.1KV 3 CORE x 2.5sqmm Cu SWA CABLE	1 METER
6	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	1 EACH
7	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
8	100x100x6mm THK. MILD STEEL PLATE, GALVANISED	1 EACH
9	STDM RED HEAD ANCHOR AND BOLTS	4 EACH
10	CABLE TRAY – 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
11	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	2 EACH
12	S-HOOK	2 EACH

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PLATED.
3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
4. ALL DAMAGE TO GALVANISED FINISHES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
5. THE LENGTH OF SUPPORT (CLUTCH WIRE) SHALL BE ADJUSTED TO MAINTAIN THE REQUIRED ELEVATION MARKED IN LIGHTING LAYOUT.

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS			NLC TAMILNADU POWER LIMITED				
2X500MW THERMAL POWER PLANT AT TUTICORIN			DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS				
DS	SM	BG	-	12.02.19	JOB NO. 18A09	SCALE : NTS	
APPVD.	REVWD.	CHKD.	REV.	DATE	DWG. NO. 18A09-DWG-E-0800	SHT. 12 OF 25	REV.



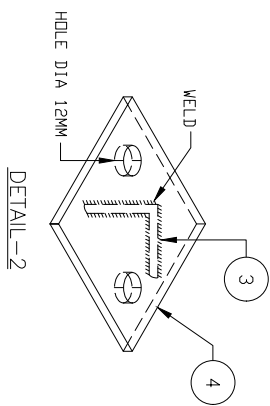
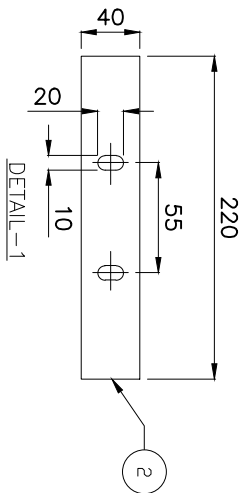
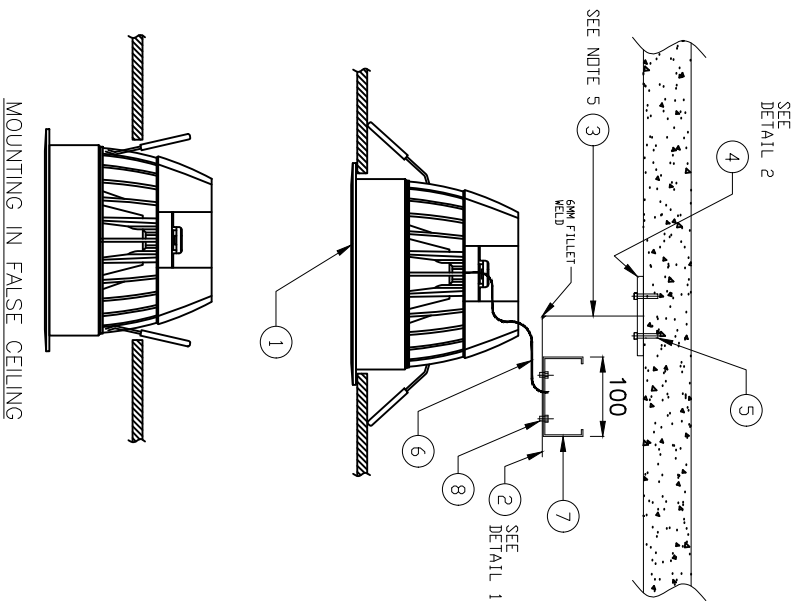
ITEM NO.	DESCRIPTION	QTY.
1	RECESSED MOUNTED LUMINAIRE-CHIEFUS RC 3658 LED22 4000 PSU OD WH OR EQUIVALENT	1 NO
2	CHAIN	AS REQUIRED
3	T- SECTION OF THE CEILING STRUCTURE	AS REQUIRED
4	FALSE CEILING	AS REQUIRED
5	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	2 EACH
6	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
7	100x100x6mm THK. MILD STEEL PLATE, GALVANISED	1 EACH
8	ST0M RED HEAD ANCHOR AND BOLTS	2 EACH
9	CABLE TRAY - 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
10	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	2 EACH
11	JUNCTION BOX	1 NO

ELECTRICAL INSTALLATION OF RECESSED MOUNTED LUMINAIRE IP 20, SUITABLE FOR 2x2 GRID(600mm X 600mm) CIRCUIT OR EQUIVALENT (TYPE-LG)

- NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETERS (mm)
 2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANIZED OR ZINC PASSIVATED
 3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED
 4. AFTER DRILLING, THE CHANNEL IS TO BE PREPARED, PRIMED AND PAINTED.

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS		NLC TAMILNADU POWER LIMITED		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09 SCALE : NTS		
DWG. NO. 18A09-DWG-E-0800			SHT. 13 OF 25		
			REV. -		



**ELECTRICAL INSTALLATION OF RECESSED MOUNTED GREEN LED
DOWN LIGHT 2x24W/2x15W, TYPE LD**

ITEM No.	DESCRIPTION	QUANTITY
1	CFL DOWNLIGHTER LUMINAIRE - 2x24W GREEN LED DN1948 LED15S-4000 PSU WH/2x15W GREEN LED DN1928 LED9S-4000 PSU WH OR EQUIVALENT	1 EACH
2	40x6x220mm LONG MILD STEEL FLAT, GALVANISED	1 EACH
3	50x50x6mm THK. MILD STEEL ANGLE, GALVANISED	AS REQUIRED
4	100x100x6mm THK. MILD STEEL PLATE, GALVANISED	1 EACH
5	STOM RED HEAD ANCHOR AND BOLTS	2 EACH
6	CABLE - 1.1KV 3 CORE x 2.5sq.mm Cu SWA CABLE	1 METER
7	CABLE TRAY - 100mm WIDE MILD STEEL, GALVANISED	AS REQUIRED
8	M6x25mm LONG MILD STEEL PAN HEAD SCREW COMPLETE WITH NUT & WASHER	AS REQUIRED

- NOTES :-**
1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
 2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PLATED.
 3. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
 4. ALL DAMAGE TO GALVANISED FINISHES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
 5. THE LENGTH OF SUPPORT SHALL BE ADJUSTED TO MAINTAIN THE REQUIRED HEIGHT OF THE CABLE TRAY.

DS	SM	BG	-	12.02.19
APPVD.	REVMD.	CHKD.	REV.	DATE

**ILLUMINATION
NOTES & DETAILS**

NLC TAMILNADU POWER LIMITED

2X500MW THERMAL POWER PLANT
AT TUTICORIN

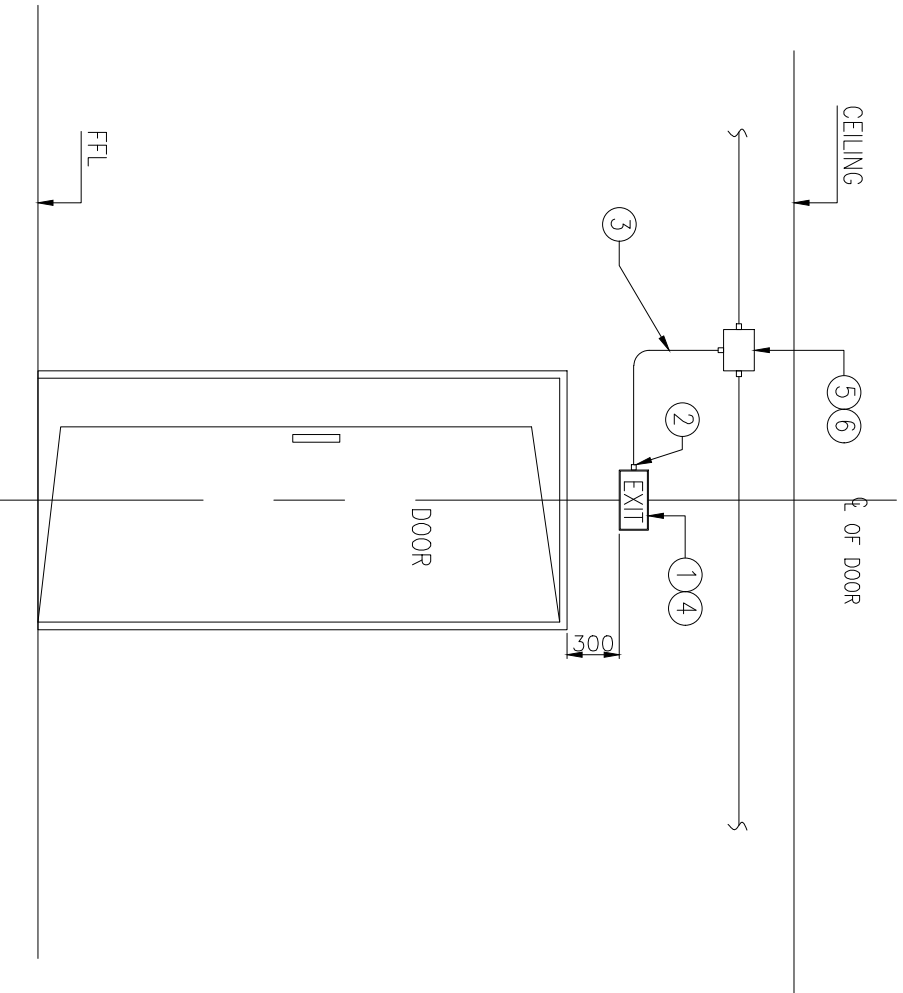
FOR TENDER PURPOSE ONLY

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

JOB NO. 18A09 SCALE : NTS

DWG. NO. 18A09-DWG-E-0800 REV. -

SHT. 14 OF 25





EMERGENCY EXIT LIGHTING SIGN

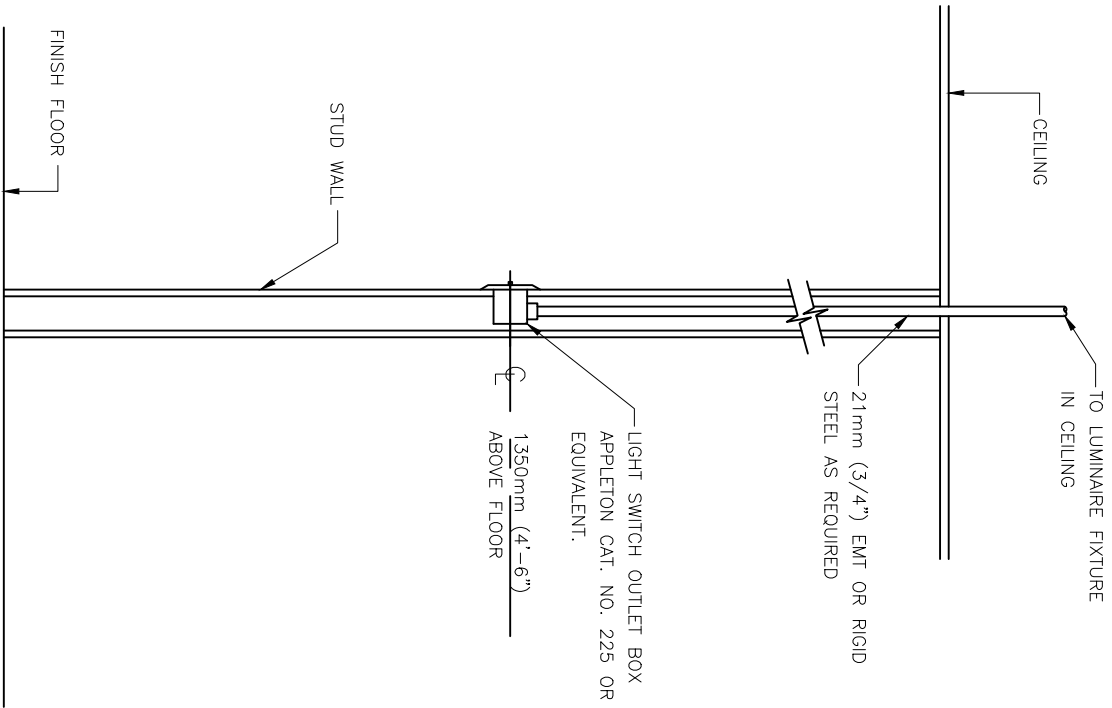
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS (mm)
2. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANIZED OR ZINC PASSIVATED

ITEM NO.	DESCRIPTION
1	EMERGENCY EXIT SIGN
2	CABLE GLAND TO SUIT ITEM NO. 3
3	30x2.5 Sqmm XLPE, SWA CABLE
4	4.0 BRASS FIXING SCREW x 41 Lg.
5	JUNCTION BOX
6	M6x25mm Lg. MILD STEEL BOLT HEX. HEAD PLATED C/W NUT & WASHER



FOR TENDER PURPOSE ONLY

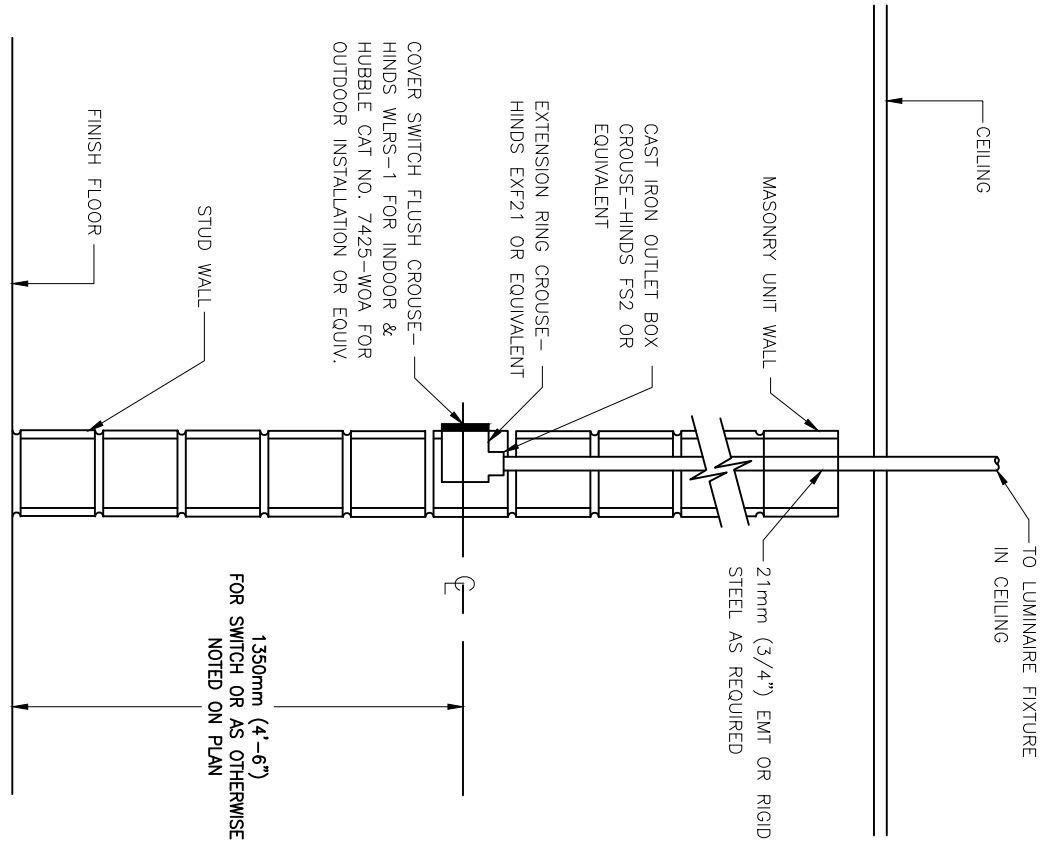
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				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS					
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09	SCALE : NTS
APPVD.	REVMD.	CHKD.	REV.	DATE	DWG. NO. 18A09-DWG-E-0800			SHT. 15 OF 25	REV.



FLUSH MOUNTED SWITCH BOX IN A STUD WALL



FOR TENDER PURPOSE ONLY

						 ILLUMINATION NOTES & DETAILS	
						 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	NLC TAMILNADU POWER LIMITED 2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO. 18A09
APPVD.	REVWD.	CHKD.	REV.	DATE			SCALE : NTS
							DWG. NO. 18A09-DWG-E-0800
							SHT. 16 OF 25
							REV. -



FLUSH MOUNTED SWITCH BOX IN A BLOCK WALL

FOR TENDER PURPOSE ONLY

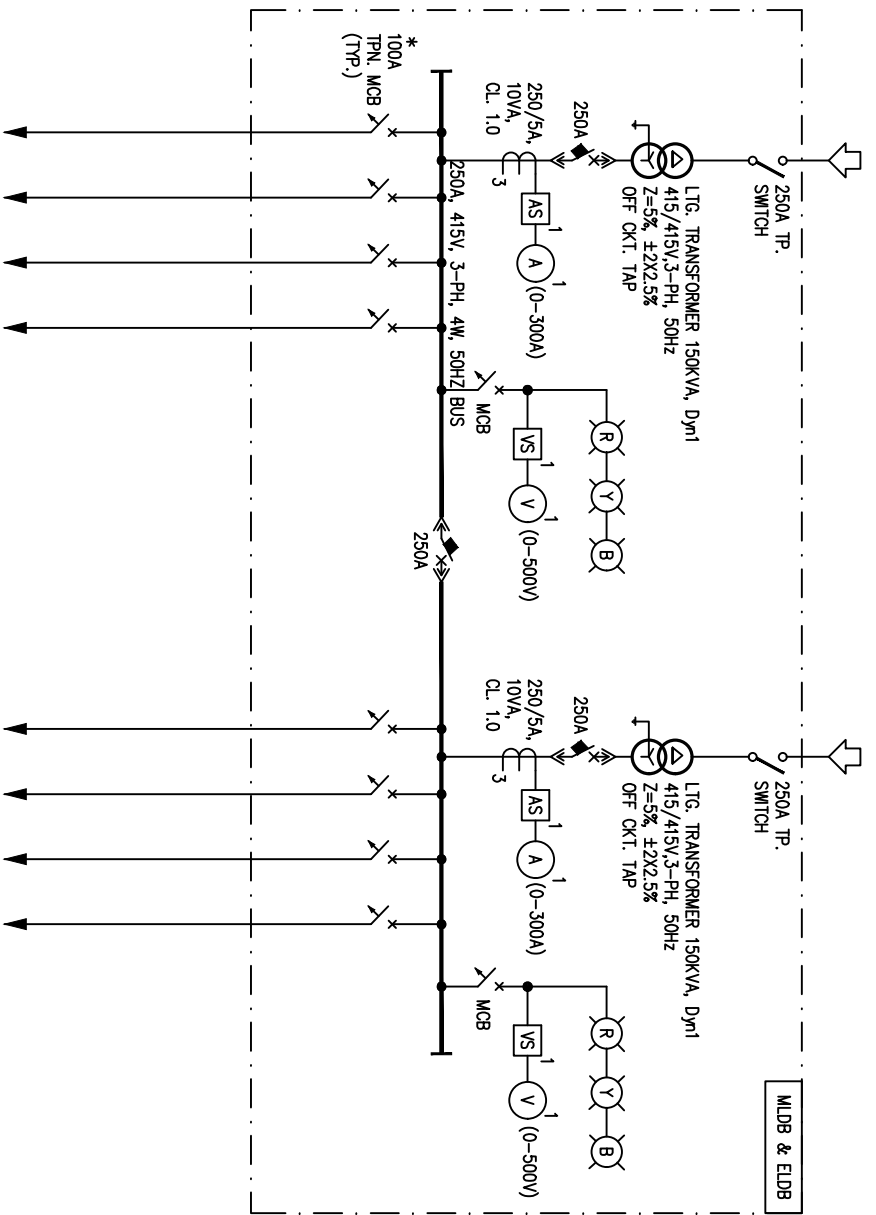
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APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO.	18A09	SCALE :	NTS	REV.
DS	SM	BG	-	12.02.19			DWG. NO.	18A09-DWG-E-0800			
					AT TUTICORIN		SHT.	17 OF 25			

LOCATION	NO. & TYPE OF FIXTURE (WATT)	LOAD CKT. NO.					CKT. LOAD NO. (WATT)	NO. & TYPE OF FIXTURE	LOCATION	
		1					10			
		2					11			
		3					12			
		4					13			
		5					14			
		6					15			
		7					16			
		8					17			
		9					18			

3-LINE DIAGRAM : LIGHTING PANEL

FOR TENDER PURPOSE ONLY

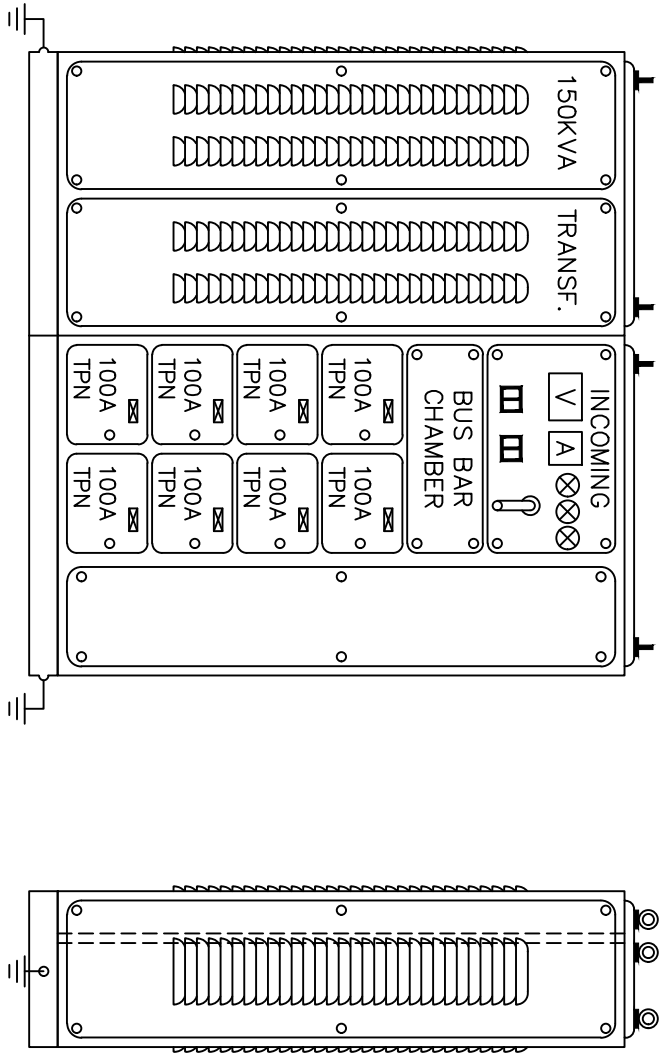
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NLC TAMILNADU POWER LIMITED					
2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09		
APPVD. REVMD. CHKD. REV. DATE			DWG. NO. 18A09-DWG-E-0800		
DS	SM	BG	-	12.02.19	SCALE : NTS
					REV. -



SLD : MAIN LIGHTING DISTRIBUTION BOARD

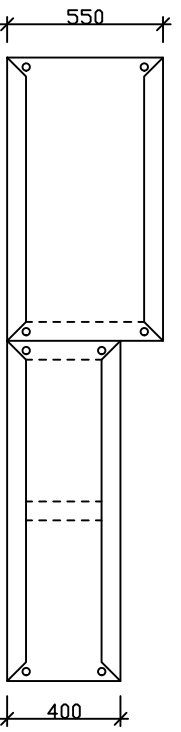
FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS										
NLC TAMILNADU POWER LIMITED										
DEVELOPMENT CONSULTANTS PVT. LTD.										
CONSULTING ENGINEERS										
APPVD.	REVMD.	CHKD.	REV.	DATE	JOB NO. 18A09					SCALE : NTS
DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-0800					REV.
					2X500MW THERMAL POWER PLANT AT TUTICORIN					



FRONT VIEW



SIDE VIEW

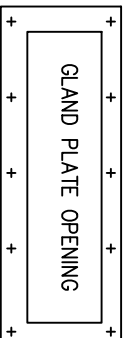
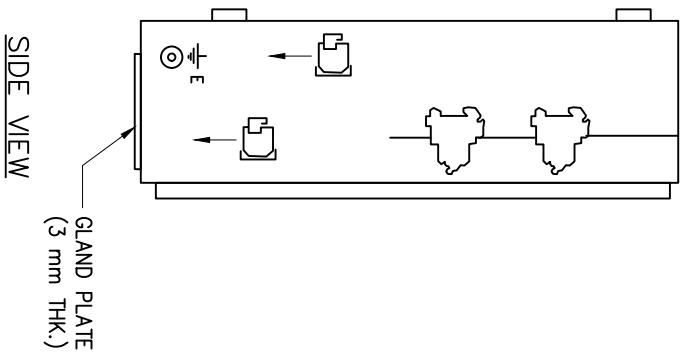
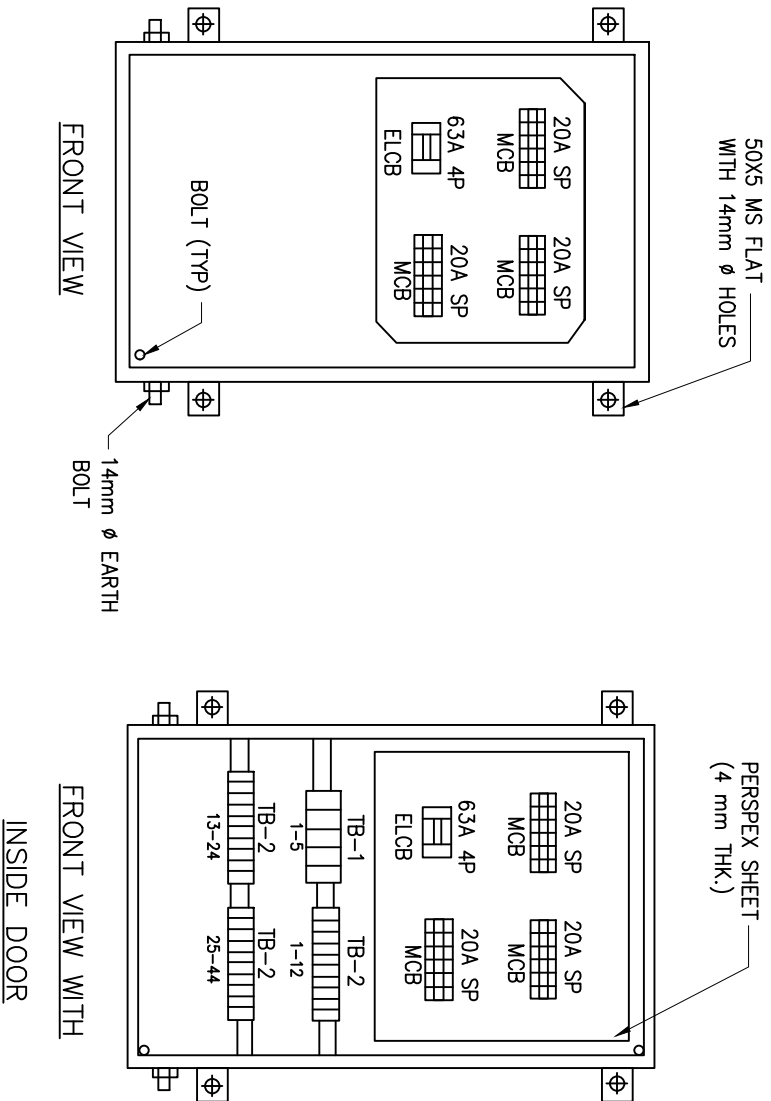


FOUNDATION PLAN

TYPICAL GENERAL ARRANGEMENT : MAIN LIGHTING DISTRIBUTION BOARD



FOR TENDER PURPOSE ONLY

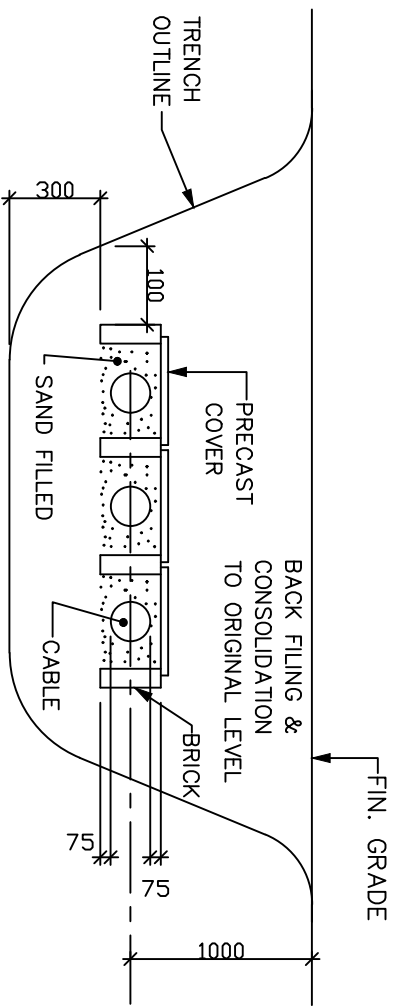
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				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-0800 SH.T. 20 OF 25	
APPVD.	REVMD.	CHKD.	REV.	DATE	SCALE :	NTS	REV.
DS	SM	BG	-	12.02.19			-



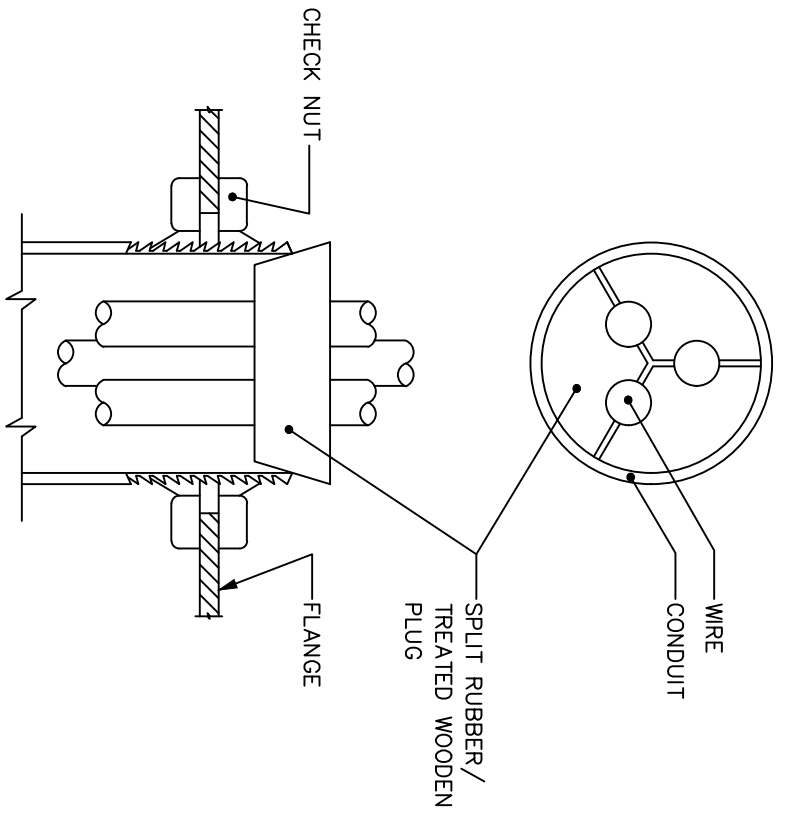
TYPICAL GENERAL ARRANGEMENT DRAWING FOR LIGHTING PANEL

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS				 NILG TAMILNADU POWER LIMITED			
2X500MW THERMAL POWER PLANT AT TUTICORIN				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
APPVD.	REVMD.	CHKD.	REV.	DATE	JOB NO.	SCALE :	REV.
DS	SM	BG	-	12.02.19	18A09	NTS	-
DWG. NO. 18A09-DWG-E-0800				SHT. 21 OF 25			





TYP. DETAIL FOR BURIED CABLE

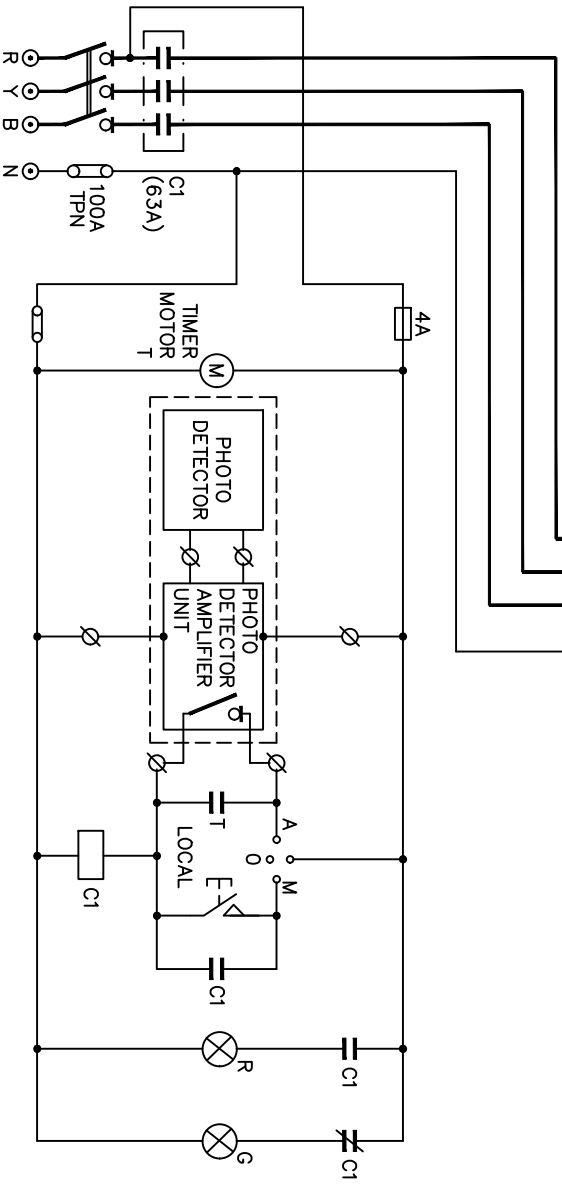


CLAMPING OF WIRES
IN CONDUIT VERTICAL RUN

FOR TENDER PURPOSE ONLY

				 ILLUMINATION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09	SCALE : NTS
DS	SM	BG	-	12.02.19		DWG. NO. 18A09-DWG-E-0800	REV.
						SHT. 22 OF 25	-

LOCATION	NO.& TYPE OF FIXTURE	LOAD CKT. (WATT) NO.	20A MCB (TYP)	R	Y	B	N	CKT. LOAD NO. (WATT)	NO.& TYPE OF FIXTURE	LOCATION
		1	X					10		
		2	X					11		
		3	X					12		
		4	X					13		
		5	X					14		
		6	X					15		
		7	X					16		
		8	X					17		
		9	X					18		



- NOTES :**
- 1...FIXTURES ON STREET LIGHTING POLES SHALL BE FED FROM THE SLPs.
 - 2...FIXTURES ON FLOOD LIGHTING TOWERS SHALL ALSO BE FED FROM THE SLPs VIA ISOLATING SWITCH IN FLP MOUNTED AT THE BASE OF FLOOD LIGHTING TOWER.

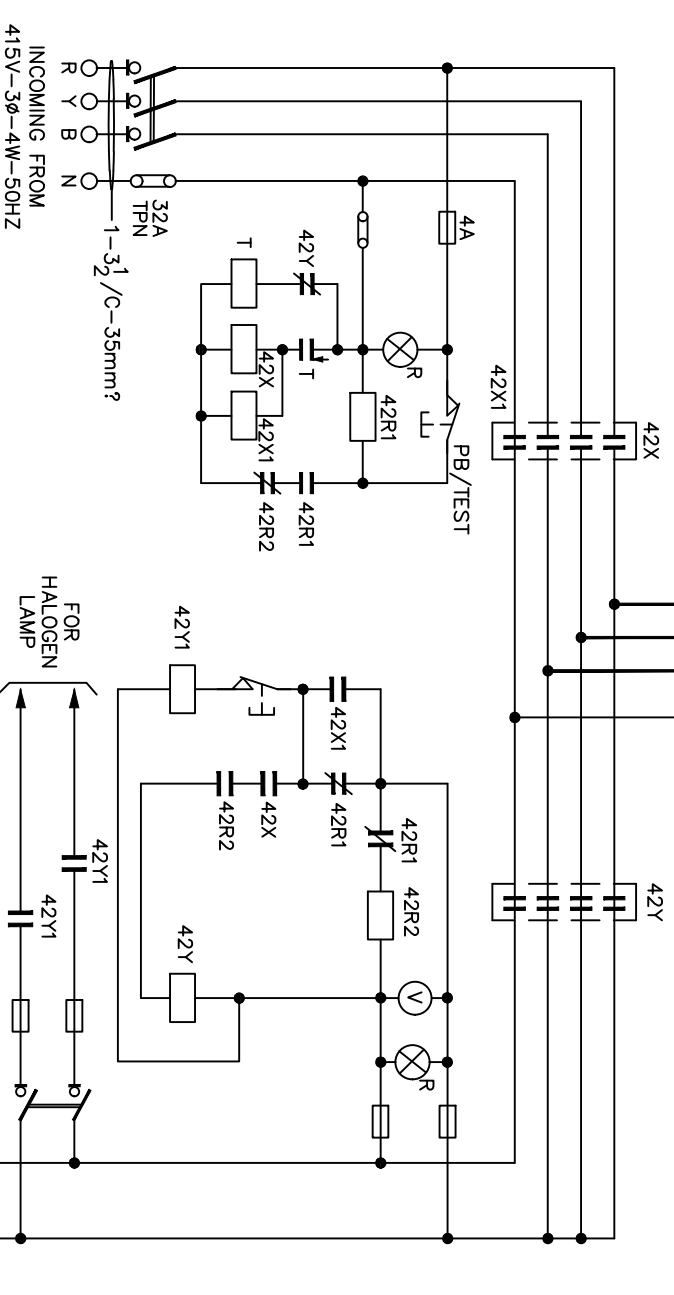
SCHEMATIC : STREET LIGHT PANELS (SLP)

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS				NLC TAMILNADU POWER LIMITED				DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS				
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN				JOB NO.	18A09	SCALE :	NTS
APPVD.	REVWD.	CHKD.	REV.	DATE					DWG. NO.	18A09-DWG-E-0800	SHT.	23 OF 25
									REV.			

LOCATION	NO. & TYPE OF FIXTURE	LOAD (WATT) NO.	CT. NO. (WATT) NO.	NO. & TYPE OF FIXTURE	LOCATION
		1		1	
		3		3	
		5		5	
		7		7	
		9		9	
		11		11	
		2		2	
		4		4	
		6		6	
		8		8	
		10		10	
		12		12	

415V-3 ϕ -4W-50HZ BUS
220V-2W-DC BUS



LEGEND: -

- 42X & 42X1 : AC CONTACTOR 3-POLE, 32A
- 42Y : DC CONTACTOR 4-POLE, 100A
- 42R1 : AUX. CONTACTOR 240V AC.
- 42R2 : AUX. CONTACTOR 220V DC
- 42Y1 : AUX. CONTACTOR 220V DC.
- T : TIMER

NOTES: -

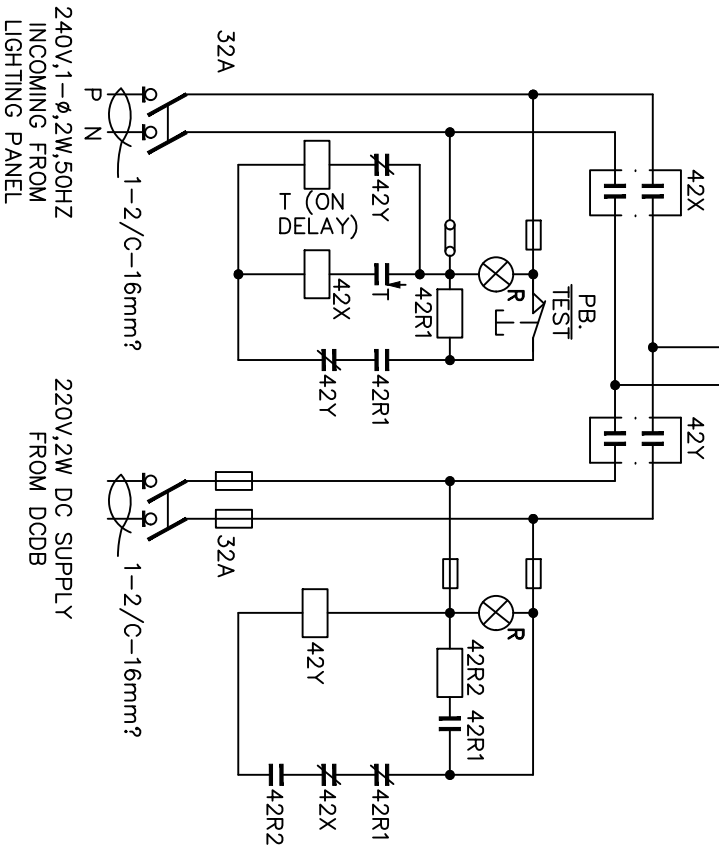
- 1.. CKT. SHOWN HERE IS IN RESET AND DE-ENERGISED POSITION.
- 2.. ALL SWITCH FUSE UNITS, AC AND DC CONTACTORS, RELAYS, LAMPS, METERS SHOWN IN THIS DRG. SHALL BE FURNISHED WITH EMERGENCY LTG. BOARD.
- 3.. THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB.

SCHEMATIC : EMERGENCY LTG. DIST. BOARD (3 ϕ)

FOR TENDER PURPOSE ONLY

ILLUMINATION NOTES & DETAILS			NLC TAMILNADU POWER LIMITED		
APPVD. REVWD. CHKD. REV. DATE			JOB NO. 18A09		
DS	SM	BG	-	12.02.19	SCALE : NTS
2X500MW THERMAL POWER PLANT AT TUTICORIN			DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
DWG. NO. 18A09-DWG-E-0800			SHT. 24 OF 25		
REV. -			REV. -		

LOCATION	NO. & TYPE OF FIXTURE	LOAD (WATT)	CKT. NO.	220V,1- ϕ ,2W,50HZ BUS 220V,2W,DC BUS	CKT. NO.	LOAD (WATT)	NO. & TYPE OF FIXTURE	LOCATION
			1					
			2					
			3					
			4					



LEGEND :-

- 42X : AC CONTACTOR, 2-POLE, 32A
- 42Y : DC CONTACTOR, 2-POLE, 32A
- 42R1: AUX. CONTACTOR 240V AC.
- 42R2: AUX. CONTACTOR 220V DC.
- T : TIMER

NOTES :-

1. CKT. SHOWN HERE IS IN RESET AND DE-ENERGISED POSITION.
2. ALL SWITCH FUSE UNITS, AC AND DC CONTACTORS, RELAYS, LAMPS, METERS SHOWN IN THIS DRG. SHALL BE FURNISHED WITH EMERGENCY LTG. BOARD.
3. THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB.

SCHEMATIC : EMERGENCY LTG. DIST. BOARD (1 ϕ)

FOR TENDER PURPOSE ONLY

				ILLUMINATION NOTES & DETAILS		 NLC TAMILNADU POWER LIMITED		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO.	18A09	SCALE :	NTS
DS	SM	BG	-	12.02.19			DWG. NO.	18A09-DWG-E-0800	REV.	-
							SHT.	25 OF 25		



LIGHTNING
PROTECTION
NOTES & DETAILS

DWG. NO. 18A09-DWG-E-1000

FOR TENDER PURPOSE ONLY

1.0 AIR TERMINATIONS

- 1.1 Vertical air terminal rods shall be installed on the top of all structured/buildings to be protected from lightning strokes.
- 1.2 Vertical air terminal except those for chimney shall be 20 mm dia galvanised steel rods. The projected length of the rods including mounting structure, if any, shall be as required to protect the objects, from lightning stroke. Air terminal rods provided on top of chimney/ stack for lightning protection shall be 20 mm dia lead coated solid copper rods.
- 1.3 Air terminal rods shall be properly fixed on top of buildings/ structures to withstand wind pressure. In case the air terminal rods are embedded in the building roof, the portion embedded in the concrete shall not touch the reinforcement bars and shall be duly insulated from them.
- 1.4 All vertical air terminal rods shall be electrically connected by means of horizontal conductors (galvanised MS flats) of size 50 x 6 mm.
- 1.5 The shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 degrees.
- 1.6 Horizontal air terminations (galvanised MS flats) shall be so laid out that no part of the roof is more than nine (9) metres away from the nearest Horizontal air terminals.

2.0 SHIELDING MASTS



- 2.1 The shielding mast for lightning protection shall be installed on top of the steel column cap plates of power house main building.
- 2.2 The shielding masts shall be made of galvanised steel pipe and the heights of the same shall be decided considering the zones to be protected.
- 2.3 Each shielding mast shall be connected to grounding grid of the station by a 50 x 6 mm galvanised MS down conductor running along the building column. In addition, all power house building column joints shall be electrically bonded.

3.0 DOWN CONDUCTORS

- 3.1 The down conductors shall be 50 x 6 mm galvanised MS flats. However, The down conductor of conveyor gallery may be 25 x 4 mm galvanised MS flats.
One end of these flats shall be connected to the air terminal rods/ horizontal conductors on top of roof/structure and the other end to the nearest earth terminals.
- 3.2 Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductors of the grounding system above ground

FOR TENDER PURPOSE ONLY

18A09-DWG-E-1000 Sh. 01 OF 12 12.02.2019

					LIGHTNING PROTECTION NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS
					 NLC TAMILNADU POWER LIMITED		
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09	SCALE : NTS
APPVD.	REVWD.	CHKD.	REV.	DATE		DWG. NO. 18A09-DWG-E-1000 SHT. 01 OF 12	REV. -

A4_DD (9-96) [210x297]

- 3.3 The connection between each down conductor and earth terminal shall be made via test link located at approximately 1500 mm above ground level.
- 3.4 The down conductors shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleated on the outside of the building wall and or columns/structures at intervals of about 750 mm., unless indicated otherwise in the drawings.
- 3.5 Down conductors along the chimney shell shall be electrically connected with the reinforcement rods by suitable lugs welded (6 mm fillet) to both down conductor and reinforcement at the interval of 30 mm.
- 3.6 All exposed metallic parts of a building shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.



4.0 EARTH TERMINALS.

- 4.1 Where ground mat is available, the risers specifically ear-marked for lightning protection shall be considered as Earth Terminal. In such case, one electrode shall be provide close to the each Earth Terminals.
- 4.2 Where ground mat is not available sparate earth pit as per IS-3043 or approved international standard specifically for lightning protection shall be provided as Earth Terminal.

5.0 JOINTING & CONNECTION

- 5.1 Number of joints in the lightning conductors shall be kept to a minimum.
- 5.2 All the joints shall be done by arc welding process. Overlapping of conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be properly cleaned before jointing.
- 5.3 Those portions of galvanized steel flats, which have been welded at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.
- 5.4 After successful testing the bolted joints of test links shall be wrapped by bitumenous hessian tape followed by 3 mm thick coating of bitumen compound.
- 5.5 Air terminal rods and shielding masts shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).
- 5.6 Steel to copper connection shall be brazed type.

FOR TENDER PURPOSE ONLY

						 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
						 NLC TAMILNADU POWER LIMITED 2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09 SCALE : NTS	
DS	SM	BG	-	12.02.19			DWG. NO. 18A09-DWG-E-1000 SHT. 02 OF 12	REV. -
APPVD.	REVWD.	CHKD.	REV.	DATE				

18A09-DWG-E-1000 Sh. 02 OF 12 12.02.2019



A4_DD (9-96) [210x297]

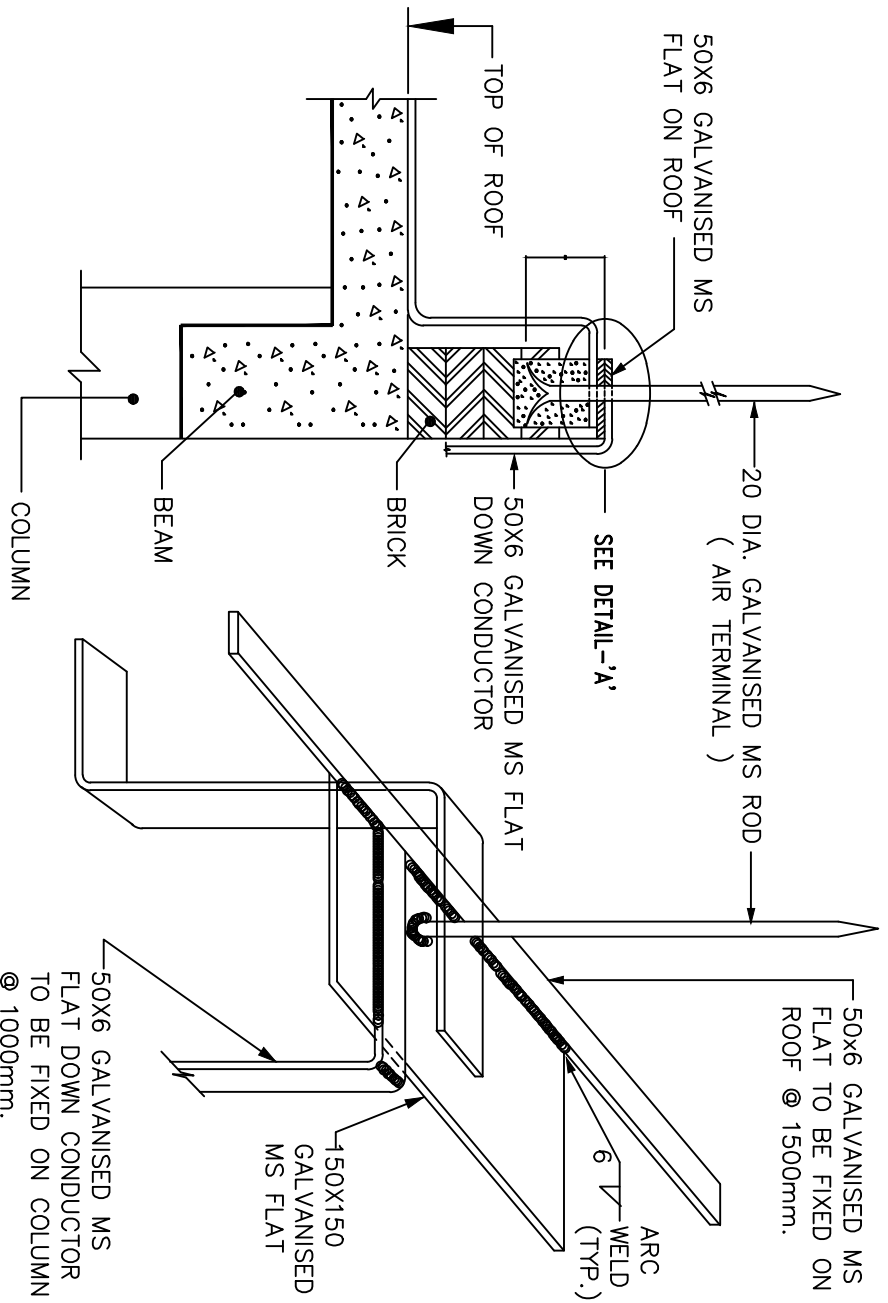
**6.0 LIGHTNING PROTECTION OF OUTDOOR SUBSTATION/
SWITCHYARD AND OTHER AREAS.**

- 6.1 *Lightning protection of outdoor switchyards/substations shall be done by lightning masts on top of steel towers. shield wires may also be used wherever required. These shall be strung across the top of the steel towers and/or building/plant structure.*
- 6.2 *The shield wire, which shall be brought down to the bottom of the steel towers, shall be connected to the earthing conductor (50 x 6 mm galvanized MS flat), which in turn, shall be connected to the riser from the main grounding mat/grid.*
- 6.3 *For lightning protection of conveyor gallery, a horizontal conductor (25 x3 mm galvanized MS flat) running along the entire length of the conveyor gallery shall be provided on top of the gallery roof. This conductor be connected to a earth terminal at approximate intervals of 30M by two down conductors, each 25 x 3 mm galvanized MS flat.*
- 7.0 *The sizes and materials of earthing conductors used in lightning protection system are listed below :*

	DESCRIPTION	SIZE	MATERIAL
a)	Vertical Air Terminals	20 mm dia rod	Galvanized Mild steel
b)	Horizontal conductors	i) 50 x 6 mm Flat	Galvanized Mild steel
		ii) 25 x 4 mm Flat	Galvanized Mild steel
c)	Down Conductors	i) 50 x 6 mm Flat	Galvanized Mild steel
		ii) 25 x 4 mm Flat	Galvanized Mild steel
d)	Riser From Electrode/ Grounding Mat	32 mm dia Rod	Mild Steel
e)	Electrode for Lighting Protection	32 mm dia Rod 3000 mm long	Mild Steel



FOR TENDER PURPOSE ONLY

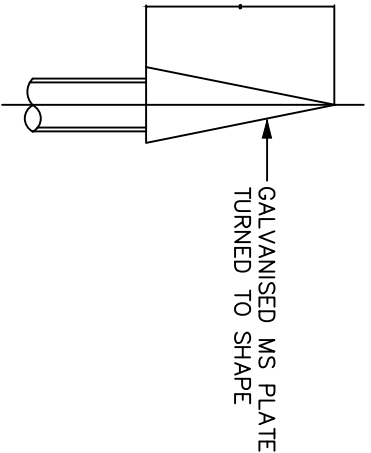
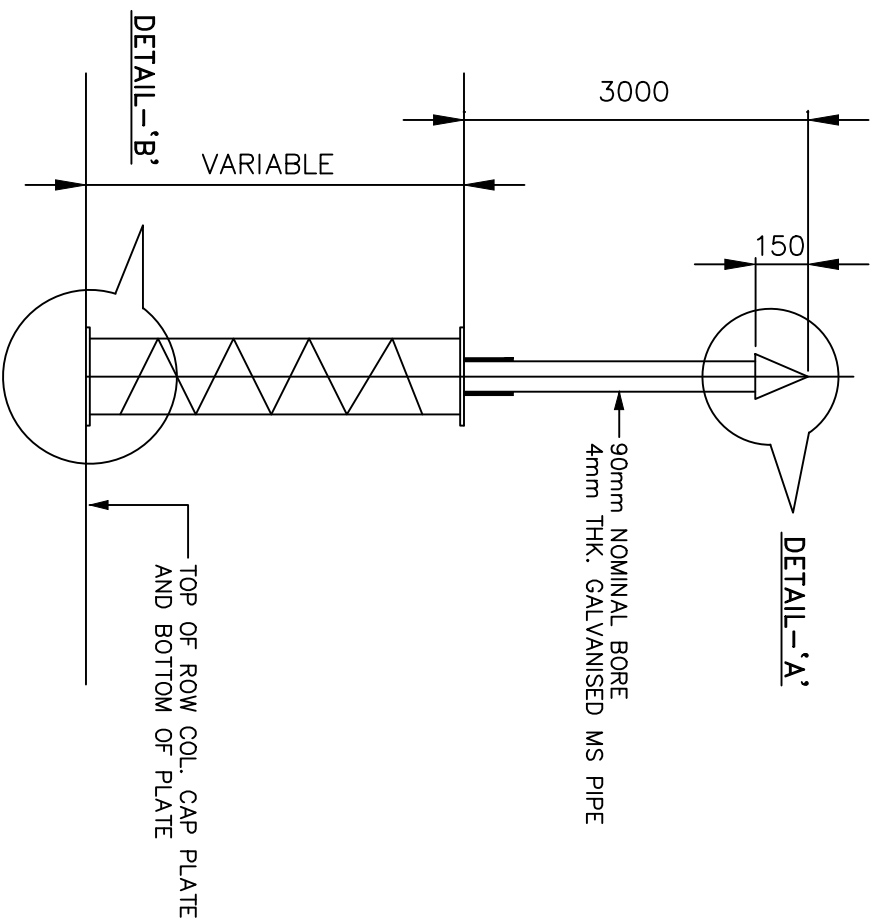
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LIGHTNING PROTECTION NOTES & DETAILS					 NLC TAMILNADU POWER LIMITED	
2X500MW THERMAL POWER PLANT AT TUTICORIN					JOB NO. 18A09 SCALE : NTS	
DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-1000 REV.	
APPVD.	REVWD.	CHKD.	REV.	DATE	SHT. 03 OF 12 -	



**FIXING DETAILS OF AIR TERMINAL ROD
ON BUILDING ROOF**
(FOR LIGHTNING PROTECTION)

FOR TENDER PURPOSE ONLY

				 LIGHTNING PROTECTION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	NLC TAMILNADU POWER LIMITED		JOB NO. 18A09
APPVD.	REVMD.	CHKD.	REV.	DATE	2X500MW THERMAL POWER PLANT AT TUTICORIN		DWG. NO. 18A09-DWG-E-1000 SHT. 04 OF 12
					SCALE : NTS		REV.

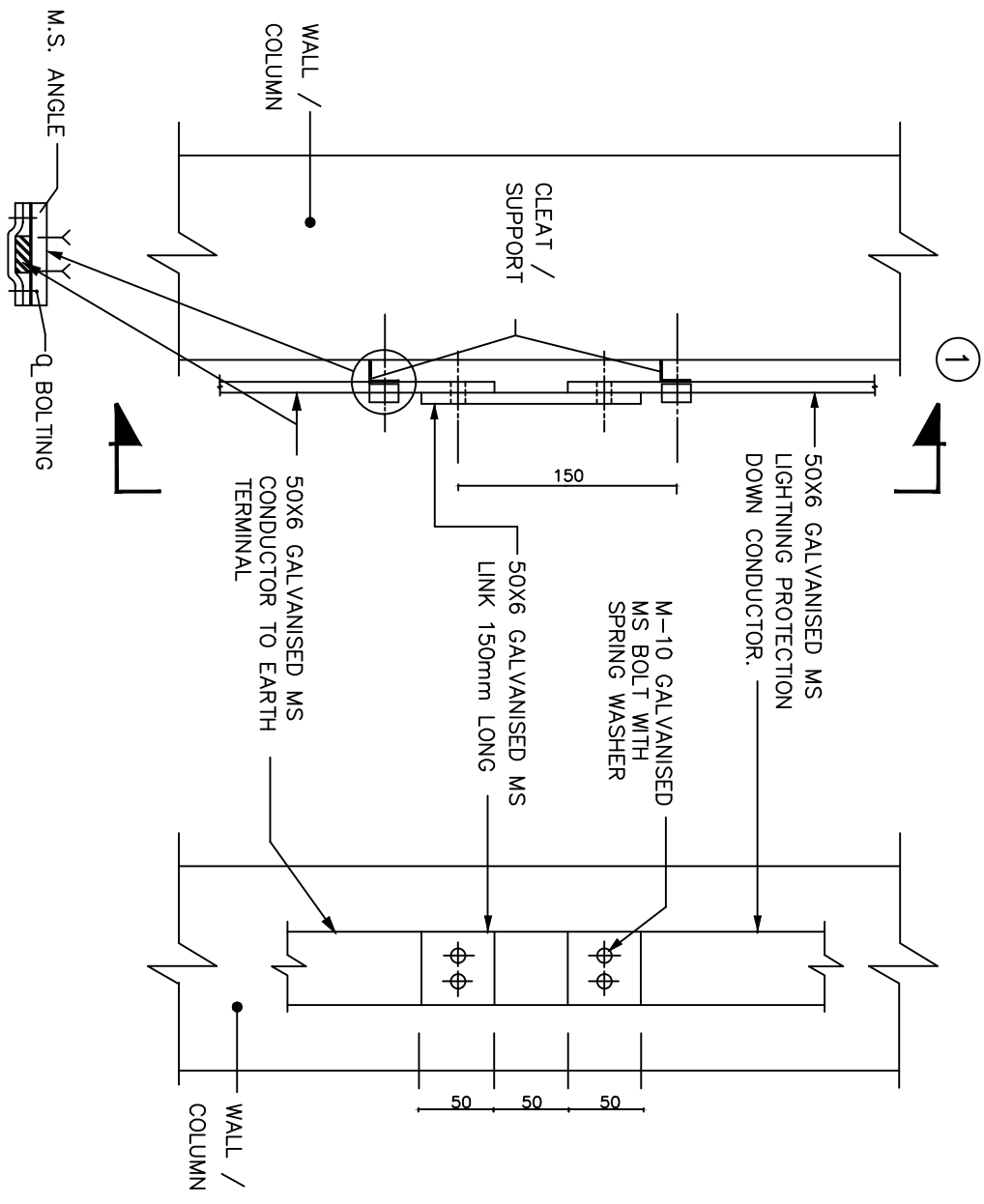


DETAIL -- A

**FIXING DETAILS OF SHIELDING
MAST ON TOP OF STEEL COLUMNS
OF POWER HOUSE BUILDING
(FOR LIGHTNING PROTECTION)**

FOR TENDER PURPOSE ONLY

				LIGHTNING PROTECTION NOTES & DETAILS		NLC TAMILNADU POWER LIMITED		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	2X500MW THERMAL POWER PLANT AT TUTICORIN		JOB NO. 18A09	SCALE : NTS	REV.
APPVD.	REVMD.	CHKD.	REV.	DATE			DWG. NO. 18A09-DWG-E-1000	SHT. 05 OF 12	





CLEATING ARRANGEMENT

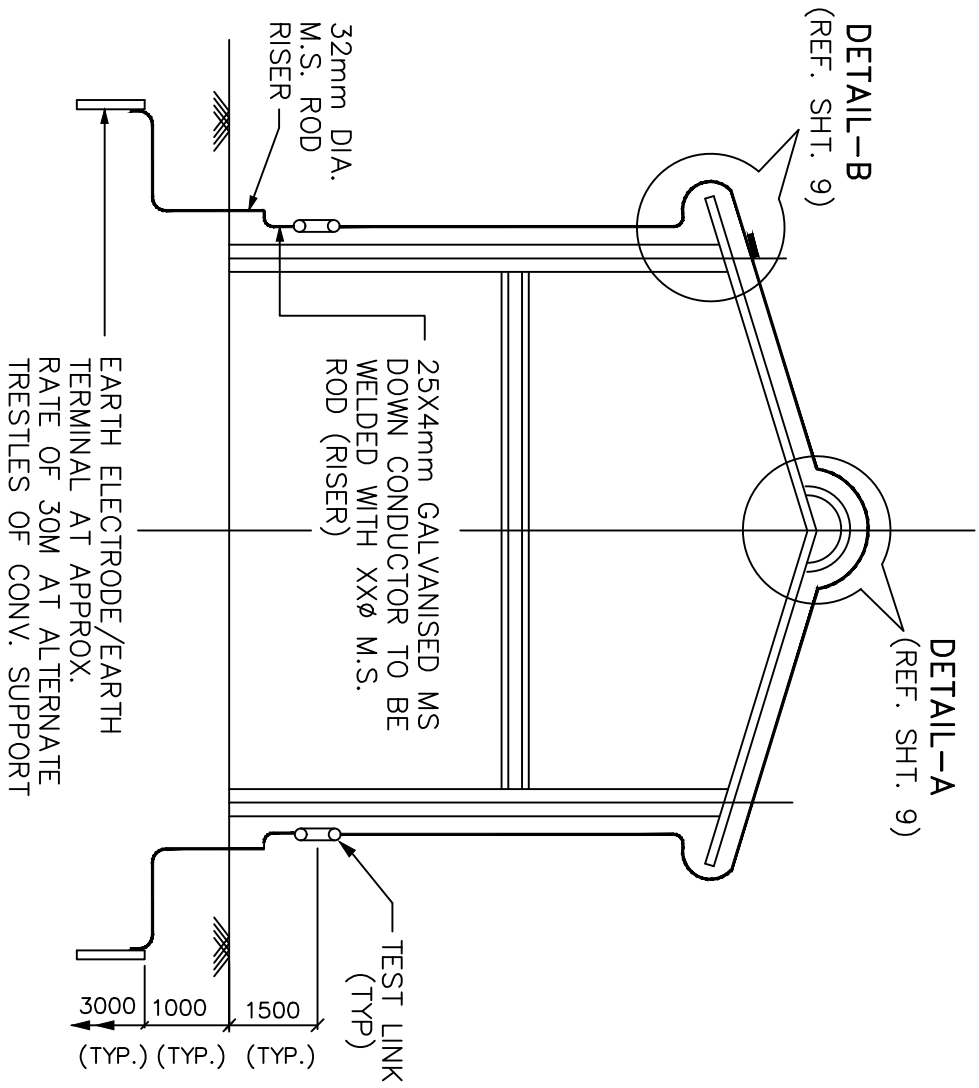
SECTION - ①

TEST LINK POINT / CLEATING ARRANGEMENT

NOTE :-
LINK POINT TO BE MOUNTED AT A HEIGHT
OF 1.5M ABOVE GROUND LEVEL

FOR TENDER PURPOSE ONLY

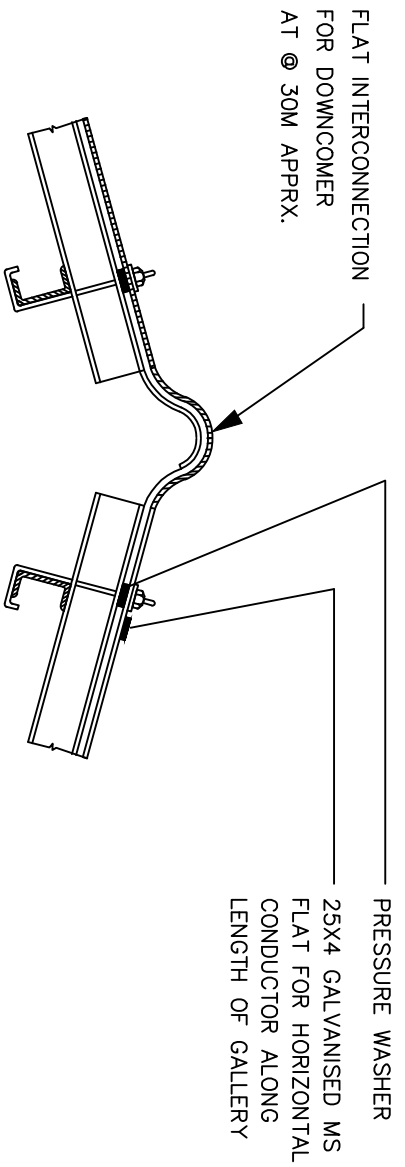
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				2X500MW THERMAL POWER PLANT AT TUTICORIN				
DS	SM	BG	-	12.02.19	JOB NO.	18A09	SCALE :	NTS
APPVD.	REVMD.	CHKD.	REV.	DATE	DWG. NO.	18A09-DWG-E-1000	REV.	-
					SHT.	06 OF 12		



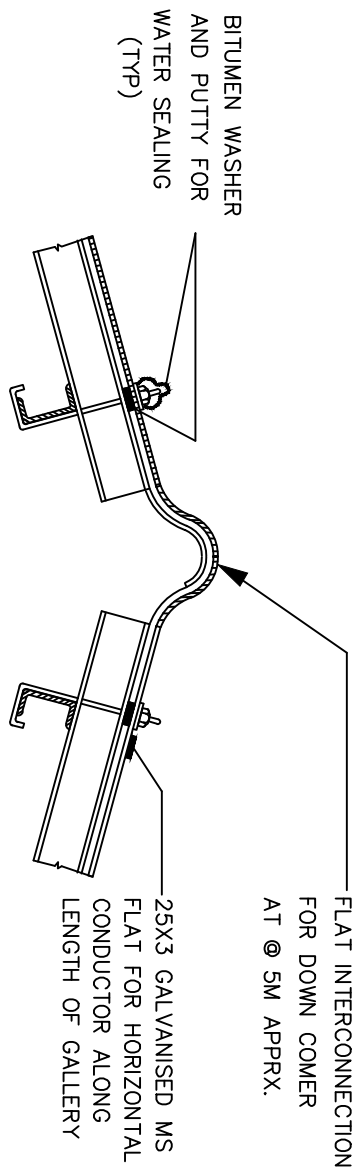
SECTION
(TYPICAL ARRANGEMENT OF DOWN
CONDUCTOR FOR CONV. GALLERY)

FOR TENDER PURPOSE ONLY

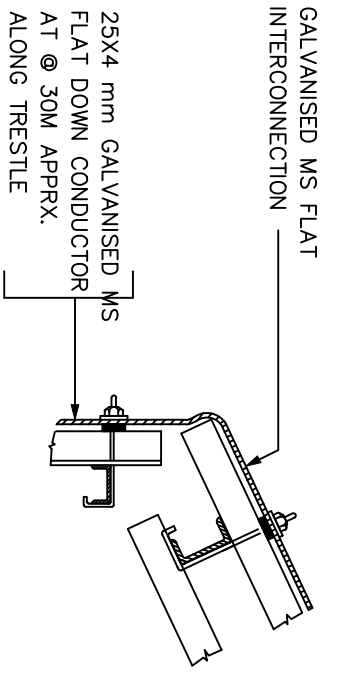
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APPVD.	REVMD.	CHKD.	REV.	DATE	
2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09		
			DWG. NO. 18A09-DWG-E-1000		
			SCALE : NTS		
			REV.		
			SHT. 07 OF 12		



DETAIL-A
(FOR DOWNCOMER)





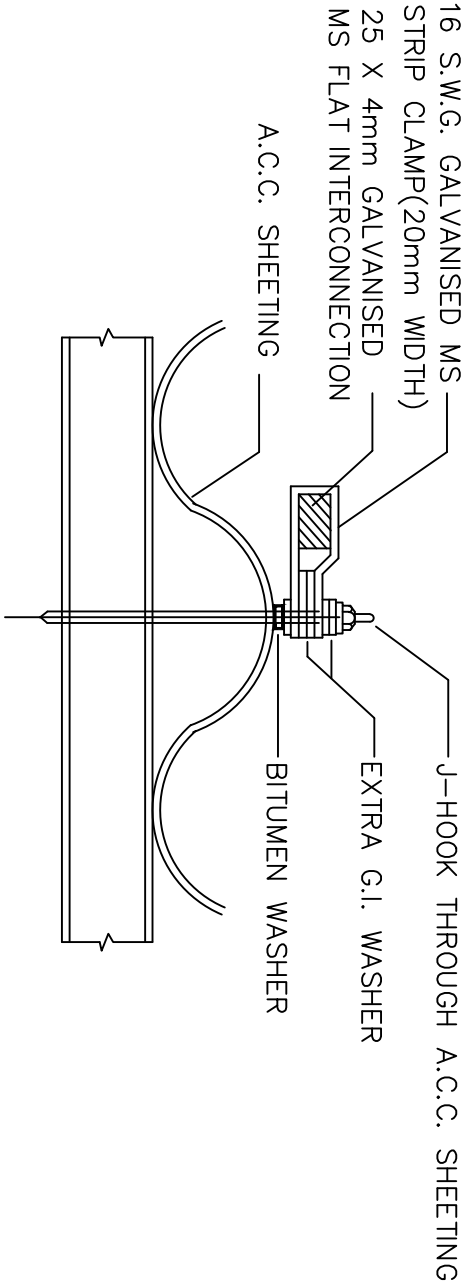
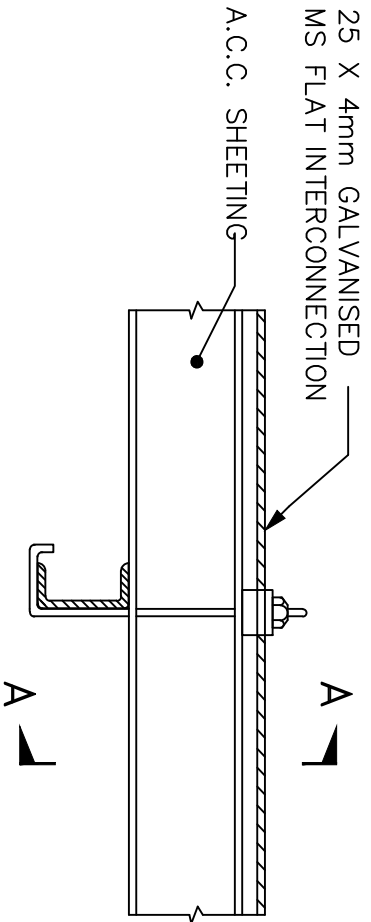
DETAIL-A
(WITHOUT DOWNCOMER)



DETAIL-B

FOR TENDER PURPOSE ONLY



				 LIGHTNING PROTECTION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		SCALE : NTS	
DS	SM	BG	-	12.02.19			
APPVD.	REVWD.	CHKD.	REV.	DATE	DWG. NO. 18A09-DWG-E-1000		
					SHT. 08 OF 12		
					REV.		

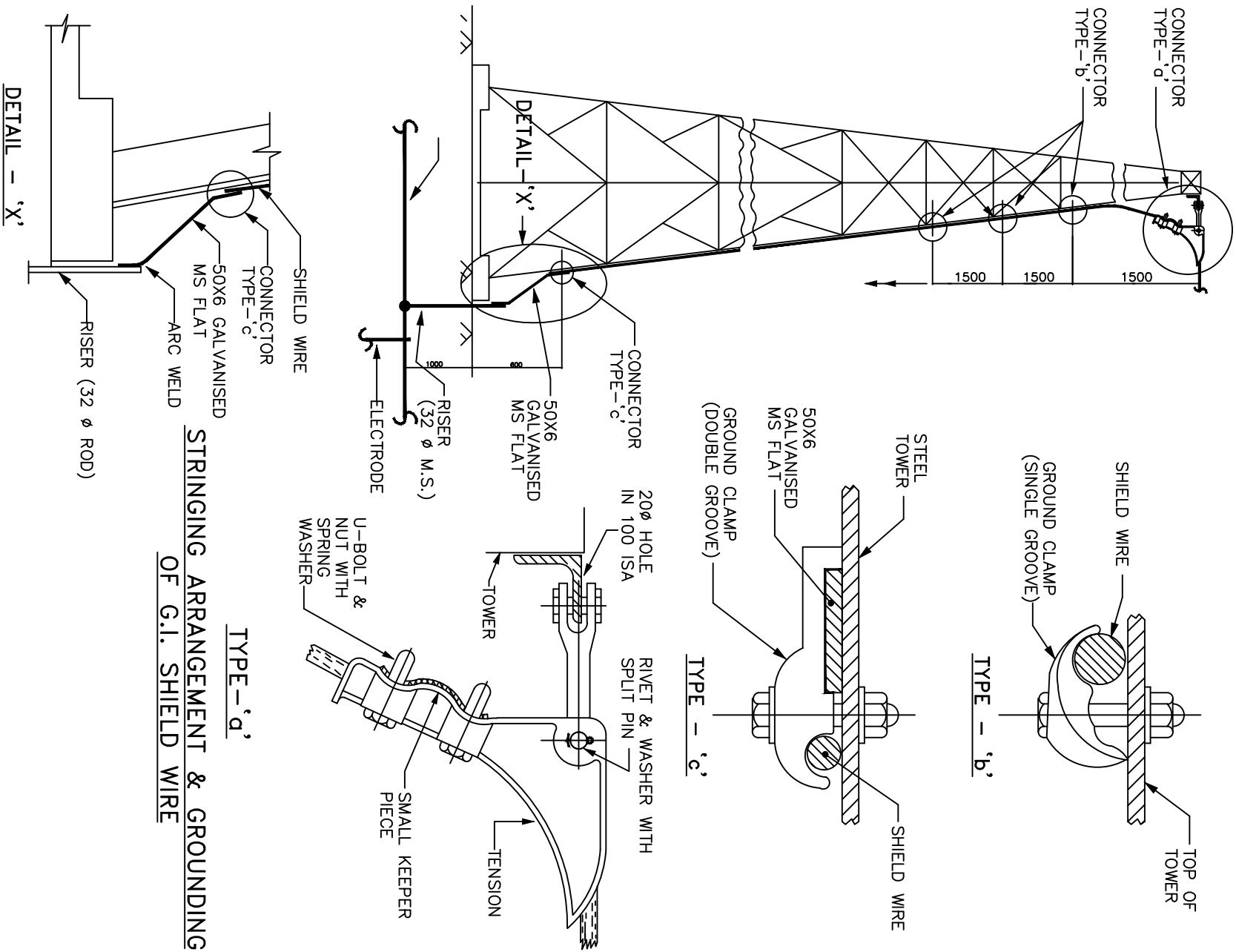


SECTION - A-A

TYPICAL FIXING ARRANGEMENT OF
GALVANISED MS INTERCONNECTION FLAT ON
ASBESTOS CEMENT CONCRETE (A.C.C) SHEETING
 (CONVEYOR GALLERY)

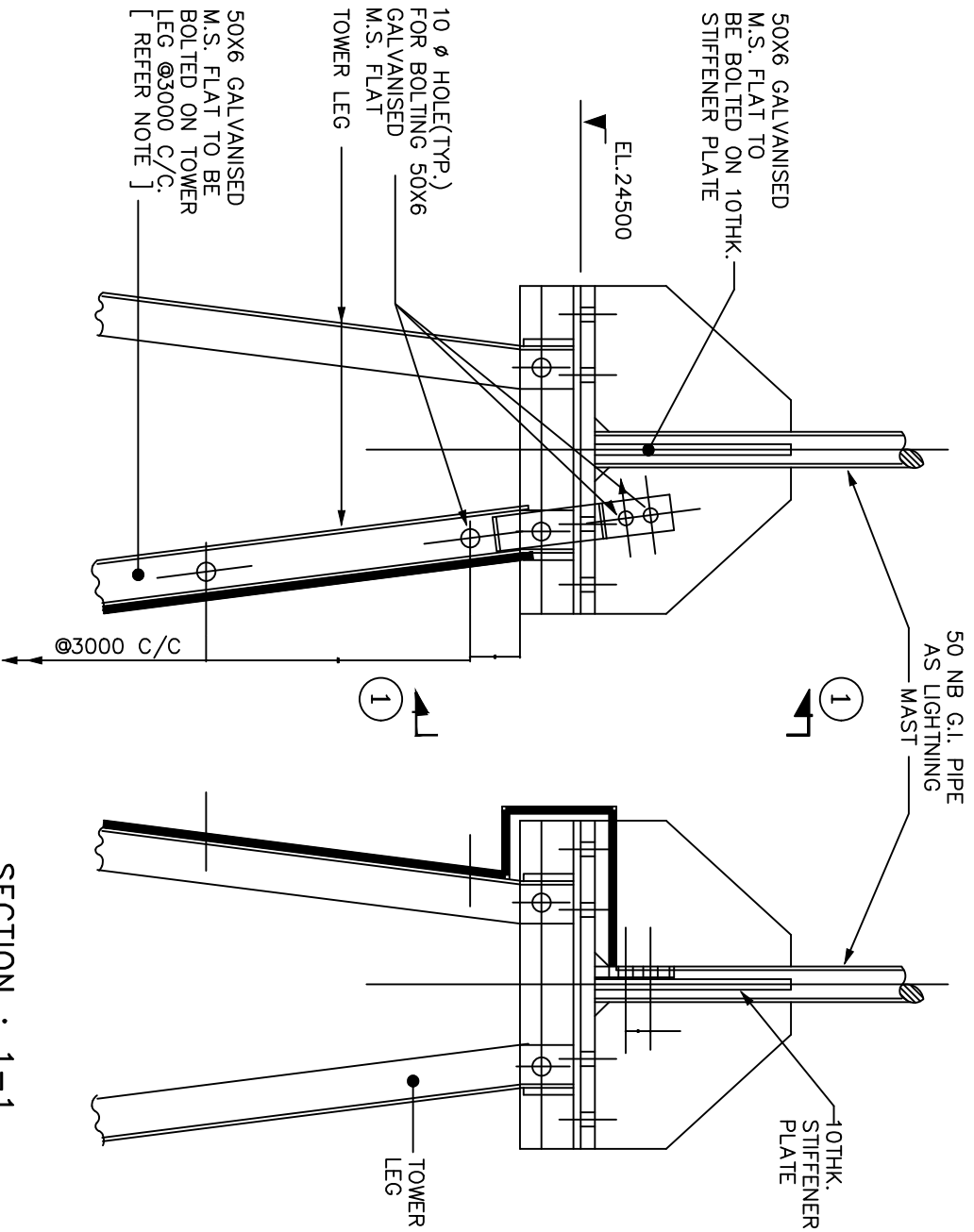
FOR TENDER PURPOSE ONLY

				 LIGHTNING PROTECTION NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
				NLC TAMILNADU POWER LIMITED		JOB NO. 18A09	
				2X500MW THERMAL POWER PLANT AT TUTICORIN		SCALE : NTS	
DS	SM	BG	-	12.02.19	DWG. NO. 18A09-DWG-E-1000		REV.
APPVD.	REVMD.	CHKD.	REV.	DATE	SH. 09 OF 12		



FOR TENDER PURPOSE ONLY



LIGHTNING PROTECTION NOTES & DETAILS				NLC TAMILNADU POWER LIMITED			
APPVD. REVMD. CHKD. REV. DATE				2X500MW THERMAL POWER PLANT AT TUTICORIN			
DS	SM	BG	-	12.02.19	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
JOB NO. 18A09				SCALE : NTS			
DWG. NO. 18A09-DWG-E-1000				SHT. 10 OF 12			
REV.				-			



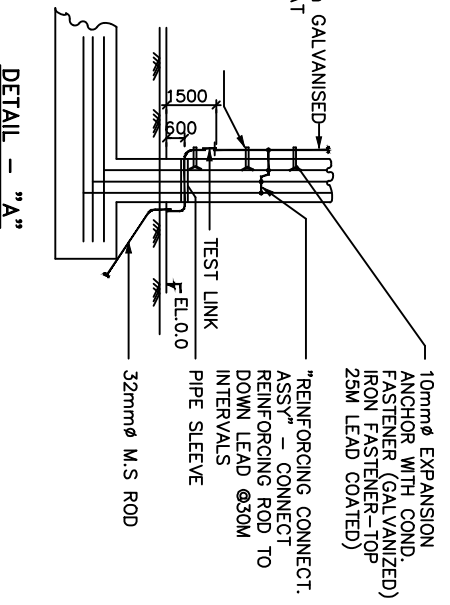
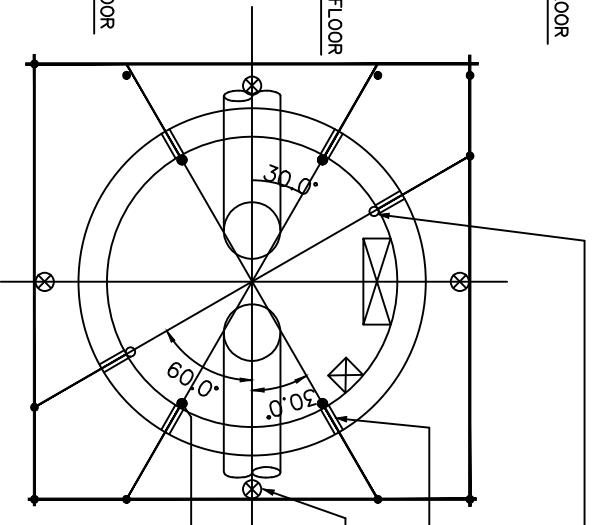
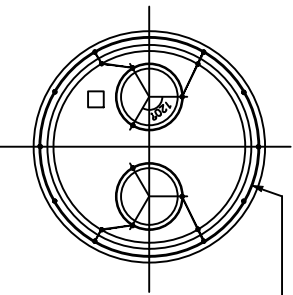
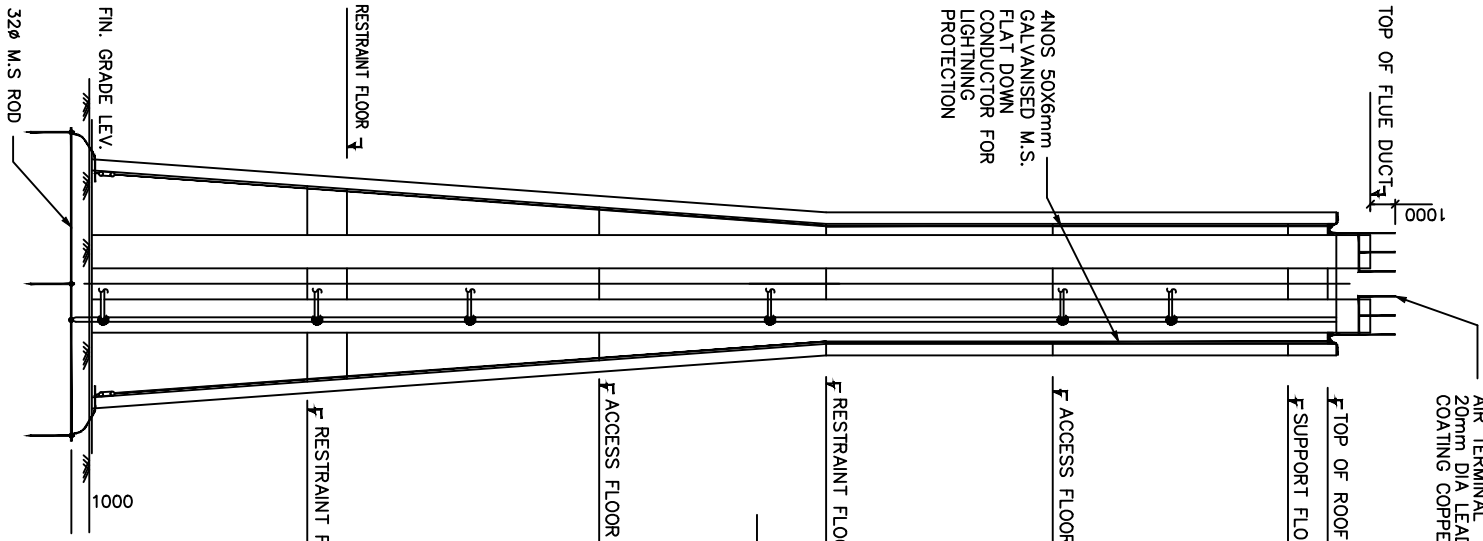
**GROUNDING OF
SUB-STATION LIGHTNING
MAST**

SECTION : 1-1

NOTE: THESE FLATS SHALL SERVE AS GROUND CONDUCTOR DOWNCOMER AND SHALL BE CONNECTED TO SUBSTATION GROUND GRID

						 NLC TAMILNADU POWER LIMITED	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS		
LIGHTNING PROTECTION NOTES & DETAILS									
DS	SM	BG	-	12.02.19		2X500MW THERMAL POWER PLANT AT TUTICORIN	JOB NO. 18A09 DWG. NO. 18A09-DWG-E-1000 SHT. 11 OF 12		
APPVD.	REVMD.	CHKD.	REV.	DATE				SCALE : NTS	REV. -

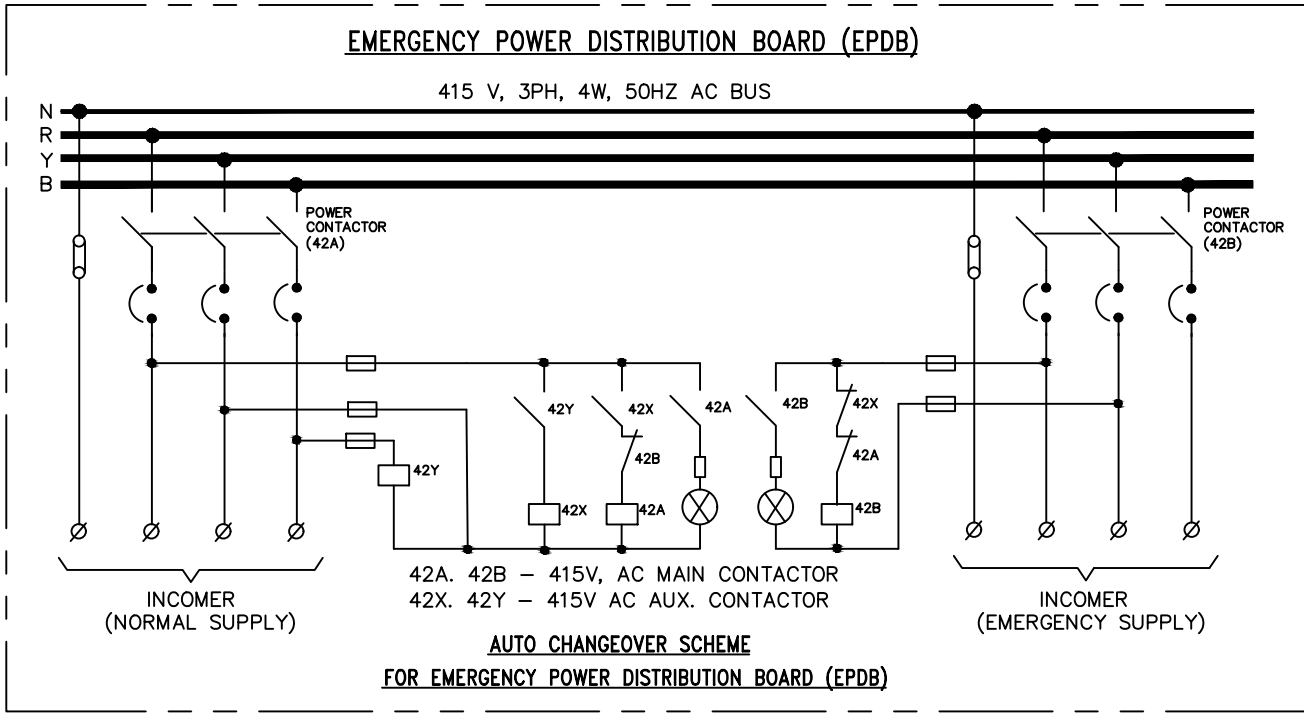
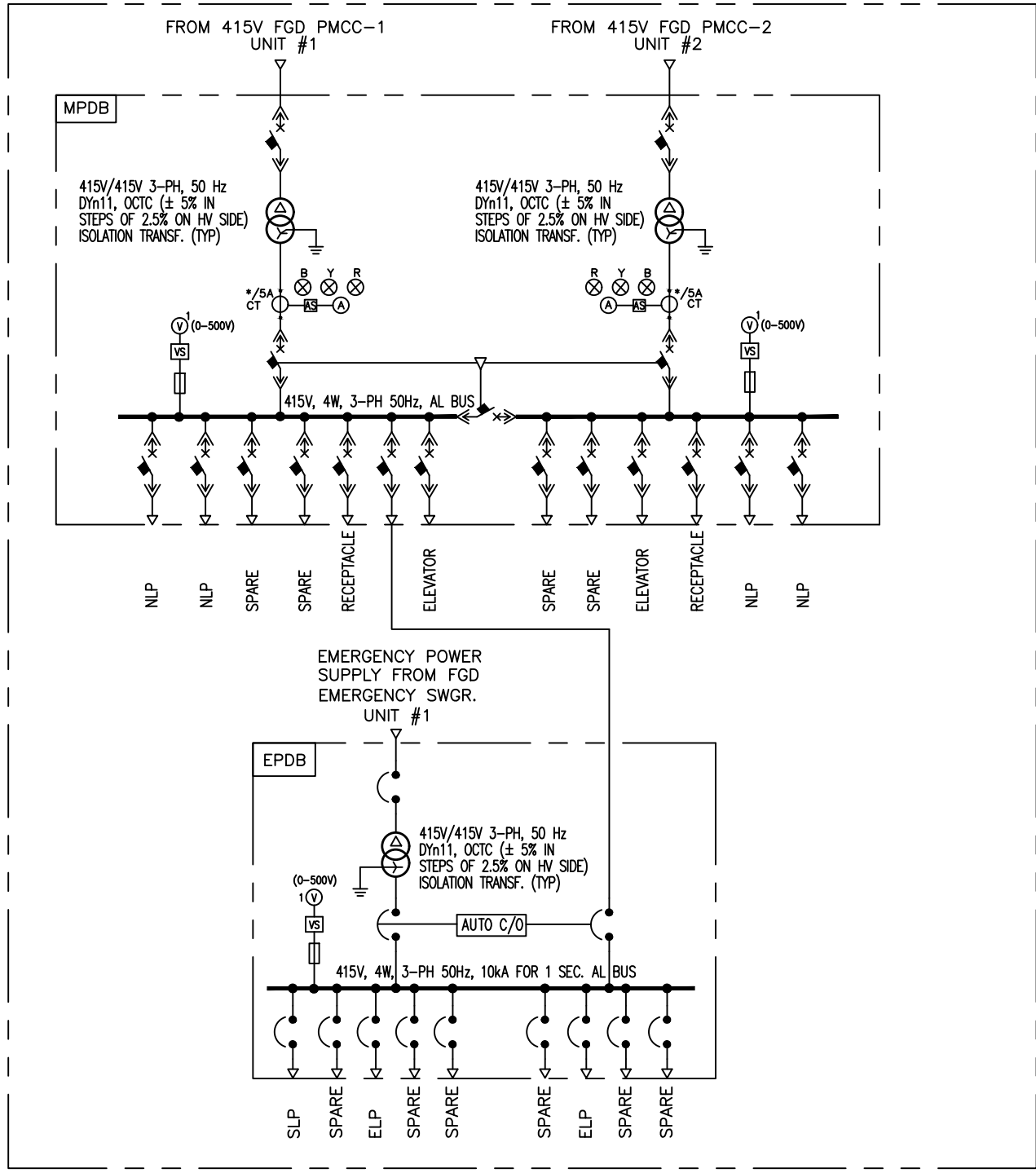
FOR TENDER PURPOSE ONLY



LIGHTNING PROTECTION ARRANGEMENT OF RCC STACK

FOR TENDER PURPOSE ONLY

LIGHTNING PROTECTION NOTES & DETAILS		NLC TAMILNADU POWER LIMITED		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	
DS	SM	BG	-	12.02.19	
APPVD.	REVWD.	CHKD.	REV.	DATE	
2X500MW THERMAL POWER PLANT AT TUTICORIN			JOB NO. 18A09 SCALE : NTS		
DWG. NO. 18A09-DWG-E-1000			REV.		
SHT. 12 OF 12					



- LEGENDS :**
- TWO WINDING TRANSFORMER
 - MCCB
 - MCB
 - DRAWOUT
 - FUSE
 - VOLT METER SELECTOR SWITCH
 - VOLT METER
 - AMMETER SELECTOR SWITCH
 - AMMETER
 - CONTACTOR
 - LINK
- SLP - STREET LIGHTING POLE
 NLP - NORMAL LIGHTING PANEL
 ELP - EMERGENCY LIGHTING PANEL
 MPDB - MAIN POWER DISTRIBUTION BOARD

FILE LOCATION: D:\DCPL\18A09\CHIMNEY\Power Distribution Diagram\18A09-CHM-DWG-E-0002.dwg
 PLOT DATE: 12-Feb-19 3:30 PM

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
				SM			DS	PRELIMINARY	0	12.02.19	BG	SM

RELEASE STATUS	DATE	SIGNATURE
✓ PRELIMINARY	12.02.19	SM
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500MW THERMAL POWER PLANT AT TUTICORIN

TITLE: SINGLE LINE DIAGRAM CHIMNEY POWER DISTRIBUTION

DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A09
CHECKED	SM	SCALE	1:1
APPROVED	DS	DATE	12.02.2019

DWG. NO. 18A09-CHM-DWG-E-0002

REV 0
1 SHEET OF 1

REPLY TO TECHNICAL QUERIES:

1. M/s. Gammon Engineers and Contractors Pvt. Ltd (GECPL)

NLCIL Sl. No.	Bidder Sl. No.	Ref. Clause of Tender Document	Existing Provision	Bidders Query	NLCIL/DCPL Reply
60.	Lot 1. Sl. No. 15.	Vol II-B, Section I, Part B, Subsection I, Clause 1.01.0	The steel flues shall be vertically supported at top & at intermediate levels (minimum four platforms) and horizontally restrained on steel platform at intervals satisfying all functional requirements.	As per this clause it is required to support flues at top and at intermediate four platform levels. Whereas tender drawing number 18A09-DWG-C-0001 shows support floor at top one level only. Please clarify is it mandatory to support flue at five level or support can be taken only from one level.	Both tender drawings and Tender specification are conveying the same. Bidder is requested to follow Tender Specification.
61.	16.	Vol II-B, Section I, Part B, Subsection I, Clause 1.02.00	Volume of Gas (at NTP 0 degree C and 1.013 bar): 734.791 Nm ³ /sec	Unit given for volume of gas shall be m ³ /sec instead Nm ³ /sec. Please clarify	Unit given for volume of gas shall be Nm ³ /sec as specified.
62.	17.	Vol II-B, Section I, Part B, Subsection I, Clause 1.02.00	Inlet-duct Center line elevation: During Detail Duct opening Dimensions: Engg. Stage	Inlet duct center line elevation and duct opening dimensions required shall be provided by client. As these are key inputs to finalize bottom diameter of chimney shell. Please provide the details.	As specified, these details will be provided during detail engineering stage after receipt and finalisation of inputs from FGD contractor.
63.	18.	Vol II-B, Section I, Part B, Subsection I, Clause 1.06.00	The Insulation shall consist of 6 layers of insulation material (resin bonded rock wool) each of a minimum thickness of 25 mm and all joints shall be staggered.	Six layer insulation requirement is throughout the height of flue or it is to be provided only for exposed portion above roof level. Please clarify.	The insulation (resin bonded rock wool) is to be provided for the flue above roof level only. Refer Vol-II-B, Section-I, Part-B, Sub Section-I, Clause 1.06.00 (vii)
64.	19.	Vol II-B, Section I, Part B, Subsection I, Clause 1.06.00.ii	Wet Chimney Condensate Collection System: To avoid the carryover of the condensate/acidic dews/water droplets/gypsum coming out of the wet chimney a condensate collection system shall be provided. Design of the condensate system should be	We presume, Wet Chimney Condensate Collection System is not in our scope of work. If it is our scope of works, please provide us the details of system. Please confirm.	It is under bidder's scope as per Tender specification and it is the responsibility of the successful bidder to provide the design and details of the system to NLCIL/NTPL/Consultant

NLCIL Sl. No.	Bidder Sl. No.	Ref. Clause of Tender Document	Existing Provision	Bidders Query	NLCIL/DCPL Reply
			such that the liquid condensate film near the exit of the stack is collected in the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the nearby area.		for approval. Refer Cl. 1.06.00 (vi) of Vol-II & Sec 1 Part B/Sub Sect. 1.
65.	LOT 2 Sl. No. 1	Vol. I-B, Draft Contract, Section 2, Scope of Supply and Services, Cl. 2.6, Page no. 20 of 158 & Vol. IIA, Section 1, Lead Specification, Cl. 7.2.0, Page 6 of 10	Cl. 2.6 Construction Power The Contractor shall be provided with construction power at 415V for the purpose of the erection construction under the Contract only at one point in the project "Site" free of charge. Cl. 7.2.0 power supply at one (1) point at 11 KV AC \pm 10%, 3 Ph, 50 Hz. \pm 5% near the erection site shall be made available with meter; cost of electricity will be charged at prevailing rate.	There is ambiguity in both the clauses regarding charges for supply of Construction Power. Cl. 2.6 of Vol. I-B states Free Supply of electricity whereas Cl. 7.2.0 of Vol. II-A states electricity will be charged at prevailing rate. Please clarify.	It is clarified that the construction power supply will be provided at 415V, free of charge, as per Cl. 2.6 of Vol. IB/ Section-2 and for "Construction Power supply" this clause of Vol-IB supersedes Cl.7.2.0 of Vol-IIA / Sec-I
66.	2.	Vol. II-B, Section 1, Part B, Sub Section 1, Cl. 3.00.00, Page 12 of 28	Ordinary Portland cement namely Grade 43 conforming to IS: 8112 (Latest Revision) shall be used for construction of all RCC structures and foundations as recommended by Owner.	We presume, we have to use OPC 43 grade cement for entire work of RCC Chimney covered under scope of works. Please confirm.	Bidders understanding is in line with Tender Specification. However, OPC 43 grade cement shall be used not only for RCC Chimney, but also for the entire scope of work as detailed in the bid document.
67.	3.	---	----	Please clarify us whether we can use Fly ash and or GGBS in concrete for all RCC works of Chimney works.	Not acceptable. Tender Condition prevails. Refer the reply given in Sl. No. 66 above.

2. Name of BHEL Unit: PEM-CIVIL

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
68.	Lot 1. Sl. No.1	Volume: II-B Section: I; Part B; Sub Section: I	1.07.00 / 10 of 28	The material of gutter including drain and base plates shall be made of suitable alloy steel to withstand design operating environment.	Please provide the material specification and properties.	Tender condition prevails. Suitable alloy steel to withstand design operating environment as per the recommendations of the Wet Stack Study report shall be used by the successful bidder.
69.	2	Volume: II-B Section: I; Part B; Sub Section: I	1.01.00 / 3 of 28	Wind tunnel study has to be done in any one of the following approved labs – SERC-Chennai, IISc-Bangalore and IIT-Kanpur and the study report shall be got approved by the owner / Consultant.	Bidder proposes that wind tunnel study has to be conducted at a reputed institution approved by bidder.	Tender Condition prevails.
70.	3	Volume: II-B Section: I; Part B; Sub Section: I	6.01.00 (7) / 17 of 28	The maximum width of opening shall be limited to an angle of not more than 30 ⁰ subtended at the center of the concrete shell. The total plan area of the openings at a particular section shall not be more than 15% of the plan area of concrete shell at that location. The opening size for the purpose of stress calculations shall be taken as 1.1 times the actual width of the opening.	These opening criteria are not in line with the IS:4998 (latest). Bidder suggests to follow the opening criteria as per IS:4998 only. Kindly confirm.	Not acceptable. Tender condition prevails.
71.	4	Volume: II-B	6.01.00 (9) /	Staircase and elevator	Staircase and elevator shall be	Tender condition prevails. However,

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
		Section: I; Part B; Sub Section: I	17 of 28	enclosures shall be provided keeping provision for a rack and pinion type electrically operated elevator.	provided separately supported on chimney shell.	this will be decided during Detailed Engineering based on the profile of the chimney without any commitment & additional cost on/ to the purchaser.
72.	5	Volume: II-B Section: I; Part B; Sub Section: I	6.02.01(1) / 17 of 28	Top 10m length (below roof) or length equal to 2 times flue diameter whichever is larger shall be provided using material confirming to AISI:316L or BS:1449. Above the roof also, the liner is of AISI:316L/BS:1449 and the height of the flue shall be as per the design requirement Acid Resistant Borosilicate brick lining shall be provided at inside face of the flue.	Bidder proposes to provide length equal to flue diameter from top, using material confirming to AISI:316L or BS:1449.	Not acceptable. Tender condition prevails. Borosilicate lining has to be provided on the inside surface of the flue can from the breaching point and up to the end of flue can.
					Bidder also understands that borosilicate glass block lining has to be provided on inside surface of flue made with material confirming to AISI:316L or BS:1449. Kindly confirm.	Bidder's understanding is in line with Tender specification.
73.	6	Volume: II-B Section: I; Part B; Sub Section: I	6.02.03 / 20 of 28	The liner hood shall be fabricated from 6 mm thick stainless steel sheets of grade 316 L. The hood shall completely cover the annular area packed with insulation material between the stainless steel flue and cladding.	Bidder understands that inside surface of flue projecting above the roof has also to be lined with borosilicate. Hence, additional insulation packing outside flue is not required. Kindly confirm.	Not acceptable. Tender condition prevails.
74.	7	Volume: II-B Section: I; Part B; Sub Section: I	6.04.00 / 22 of 28	Annular raft with hollow inside is not permitted.	Bidder proposes to allow annular raft i.e. raft with central hollow also. Kindly confirm.	Not acceptable. Tender condition prevails.
75.	8	Volume: II-B	6.05.00 /	Outer platforms shall be of	Outer chimney platform is	Not acceptable. Tender condition

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
		Section: I; Part B; Sub Section: I	22 of 28	RCC. It shall be provided as per Directorate of Air Routes & Aerodromes (DARA) Circular for locating Aviation Warning Lights and for other maintenance purposes. The platforms shall be equally spaced at a spacing of 40 m (maximum). Additional platforms for sampling ports, access doors, clean out doors etc. shall have to be provided as per requirements.	obsolete nowadays. Bidder proposes to provide openings in shell to accommodate AWL as per DARA requirement. Kindly confirm.	prevails.
76.	9	Volume: II-B Section: I; Part B; Sub Section: I	6.10.00 / 24 of 28	Staircase with handrails for chimney will be supported from top of chimney raft & from all internal platforms and not with chimney shell.....	Bidder proposes that staircase and elevator shall be provided separately supported on chimney shell and width of staircase shall be 800mm. Kindly confirm.	Tender condition prevails. However, 'support on Chimney shell' will be decided during Detailed Engineering based on the profile of the chimney without any commitment & additional cost on / to the purchaser. Width of staircase shall be as per Cl.6.10.00 / Vol-II B / Sec-I, Part-B, Sub Sec-I / Page 24 of 28. The request is not acceptable.
77.	10	Volume: II-B Section: I; Part B; Sub Section: I	7.00.00 / 27 of 28	Wind Tunnel Test for the RCC Stack is to be carried out.	Bidder understand that wind tunnel test has to be carried out for proposed new RCC chimney only. Additionally, bidder understand that no design check/ validation/ wind tunnel test of existing chimney/NDCT or any other structure is in the scope of	Tender condition prevails. Wind tunnel test shall be carried out by the successful bidder for the proposed wet RCC chimney envisaged considering all other nearby high rise structures located in the close vicinity of the proposed chimney.

NLCIL Sl. No.	Bidder Sl. No.	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
					bidder. Kindly confirm.	
78.	11	Volume: II-B Section: I; Part B; Sub Section: I	1.06.00 (VII) / 6 of 28	The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183.	Bidder understands that inside surface of flue has to be lined with borosilicate. Hence, additional insulation outside flue is not required. Kindly confirm.	Tender condition prevails. As per 1.06.00 i) & vii) Vol-II B . Sec-1, Part-B, Sub Sec-I, insulation shall be provided for the external surface of chimney flue liner projecting over the chimney roof.
79.	12	Volume: I-B Section: 2	2.1/page 14 of 158	h) Peripheral Roads / Paving (as required) along with Street Lighting.	Please confirm whether any road is to be constructed in proposed Chimney area.	The same will be furnished to the successful bidder during detailed Engineering stage.
		Volume: II-A Section: 1	4.01.00/page 5 of 10	Peripheral Roads / Paving (as required) along with Street Lighting.	If yes, then please provide the peripheral road layout.	
80.	13	Volume: II-B Section: I; Part A; Sub Section: I	-----	Guideline for Geotechnical Investigation	This is the general guideline for Geotechnical Investigation covering all general tests in soil and rock. All tests mentioned in the specification are technically not required for construction of RCC Chimney. Hence the following Geotechnical Investigation shall only be conducted: 1. 2 no. Bore holes up to 20 m depth below ground level irrespective of soil/rock strata encountered. 2. Laboratory tests on soil and rock samples collected from 2 bore holes 3. Chemical analysis of water	Tender condition prevails.

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
					<p>(2 nos.) and sub soil samples</p> <ol style="list-style-type: none"> 4. 2 no. ERT tests 5. 1 no. cross hole shear wave test 6. 1 no. Field CBR test and one laboratory CBR test <p>No other test shall be conducted. Please confirm.</p>	
81.	14	Volume: II-B Section: I; Part C; Sub Section: I Specific Design Requirements [Civil]	2.00.00/Page 1 of 19	Detail soil investigation, as required, to be carried out for foundation design of various facilities. Soil characteristics and parameters to be adopted in final design, the successful bidder is required to do detail geotechnical investigation work as part of the contract to verify/generate data so required.	<p>During detailed Geotechnical Investigation, following Geotechnical Investigation shall only be conducted:</p> <ol style="list-style-type: none"> 1. 2 no. Bore holes up to 20 m depth below ground level irrespective of soil/rock strata encountered. 2. Laboratory tests on soil and rock samples collected from 2 bore holes 3. Chemical analysis of water (2 nos.) and sub soil samples 4. 2 no. ERT tests 5. 1 no. Cross hole shear wave test 6. 1 no. Field CBR test and one laboratory CBR test <p>No other test shall be conducted. Please confirm.</p>	Tender condition prevails.
82.	15	Volume: II-B	2.00.00/Page 1	The type, size, depth of the	The type, size, depth of the	Not acceptable. Tender condition

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
		Section: I; Part C; Sub Section: I	of 19	foundation shall be based on the approved soil investigation report of Bidder/Owner's soil investigation report whichever is conservative.	foundation (open foundation or pile foundation) shall be as per approved Geotechnical Investigation Report during contract stage. Please confirm.	prevails.
83.	16	Volume: II-B Section: I; Part B; Sub Section: I General Specification & Design Criteria of Chimney – Civil & Structural Works	6.04.00/page 21 of 28	Foundation Only PILE foundation shall be provided. The bidder shall use the bore log data of Owner's Existing Soil Investigation Report for reference purpose.....The design, size, depth of the foundation shall be based on the approved soil investigation report of the successful Bidder/Owner's soil investigation report whichever is conservative.	The foundation system (Open foundation or pile foundation) shall be as per approved Geotechnical Investigation Report during contract stage. Please confirm.	Not acceptable. Tender condition prevails.
84.	17	Volume: I-B Section: 2	2.1/page 13 of 158	g) Electrical-cum-C&I building / Analyzer shelter to accommodate extractive type analyzer Panels, Data loggers / PC, DB and other necessary accessories.....	Please furnish the size (length, width and height) and finishing schedule of Electrical-cum-C&I building/Analyzer shelter. Electrical-cum-C&I building / Analyzer shelter will be rested on open foundation. Please confirm.	Not acceptable. Tender condition prevails.
85.	18	Volume: II-B Section: I; Part A; Sub Section: V	3.02.00/page 7 of 22	The piles will be bored cast-in-situ cylindrical type RCC piles of 450 mm &/or 550 mm &/or 750 mm &/or 1000 mm dia terminated within	Bored cast-in-situ RCC pile of 600 mm dia shall be used. Please confirm.	Tender condition prevails. However, this will be decided during Detailed Engineering stage.

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
				underlying sand stone layer with a rock- socket length not less than 3D		
86.	19	Volume: II-B Section: I; Part A; Sub Section: V	3.02.00/page 7&8 of 22	<p>C) Lateral Capacity The Lateral capacity of single pile, at this site, will be considered as the minimum of the following:</p> <ul style="list-style-type: none"> - i. 5 % of their respective compressive capacity of pile. <p>Lateral pile capacity assessed by the successful contractor by initial Pile Load Test</p>	Lateral capacity of pile shall be as per approved Geotechnical Investigation Report during contract stage. Lateral capacity of pile shall not be restricted to 5% of their respective compressive capacity. Please confirm.	Not acceptable. Tender condition prevails
87.	20	Volume: II-B Section: I; Part A; Sub Section: I	3.00.00/page 4 of 22	Where possible, completed boreholes shall be capped and a G.I. pipe inserted in order to preserve them for future ground water level observation. The successful bidder shall use his own materials for this and the scope shall be inclusive of the same. These bore holes after completion of observation shall be handed over to the owner in such condition as to enable future observation of ground water possible.	This activity need not to be required after taking water table during investigation. Please exclude the same.	Noted.

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
88.	21	Volume: II-B Section: I; Part A; Sub Section: I	4.02.00/4.03.00 Page 11 of 26	Static Cone Penetration Test Dynamic Cone Penetration Test	These tests cannot be performed in the proposed project site due to hard strata followed by rock and hence the same shall be excluded. Please confirm.	Tender Condition prevails.
89.	22	Volume: II-B Section: I; Part A; Sub Sect.: I	5.02.01 & 5.02.02/page 12, 13 of 26	Pump - in Test Pump - Out Test	For chimney foundation, these tests are not relevant. Please exclude the same.	Tender Condition prevails.
90.	23	Volume: II-B Section: I; Part A; Sub Sec: I	6.02.02/page 14 of 26	Direct Load Tests on Soils	For chimney foundation, this test is not relevant. Please exclude the same.	Tender Condition prevails.
91.	24	Volume: II-B Section: I; Part A; Sub Section: I	6.03/page 15 of 26	Vane Shear Tests	This test is conducted on soft clay. In proposed project site, soft clay is not encountered. Hence the same is not possible. Please exclude the same.	Tender Condition prevails.
92.	25	Volume: II-B Section: I; Part A; Sub Sec.: I	6.05/page 17 of 26	In-situ Block Shear / Wedge Shear Test	This test is not relevant for chimney foundation. Please exclude the same	Tender Condition prevails.
93.	26	Volume: II-B Section: I; Part A; Sub Sec.: I	7.00.00/page 18 of 26	TEST FOR DYNAMIC PROPERTIES	For evaluation of Dynamic properties, only cross hole shear test shall be performed. Block vibration test and cyclic plate load test shall not be conducted. Please confirm.	Tender Condition prevails.
94.	27	Volume: II-B Section: I; Part A; Sub Sect: V	3.05.00/page 9 of 22	Boring Boring shall proceed by alternatively driving the casing and extracting the bored material with the boring tools...	Boring for all piling shall be carried out by temporary casing. Please confirm.	Tender Condition prevails.

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply																		
95.	28	Volume: II-B Section: I; Part A; Sub Sec.: V	4.07.00/ page 21 of 22	Lateral Dynamic Load Test on Piles	In case of chimney foundation, this test is not required and the same shall not be conducted. Please confirm.	Tender Condition prevails.																		
96.	29	-----	-----	General	Please furnish the finished ground level (FGL) of the proposed Chimney area.	FGL of the proposed area of Wet Chimney is +2.40m +/-0.00 corresponds to finished floor level of plant which is 2.90 m from chart datum and chart datum is – 0.64m from mean sea level (MSL)																		
97.	30	-----	-----	General	Please furnish the Topographical survey drawing of the proposed Chimney area.	Since it is running plant, the necessity of topographical survey drawing may not arise.																		
98.	31	-----	-----	General	Please furnish the peripheral road layout around the proposed Chimney area.	The same will be furnished to the successful bidder during Detailed Engineering stage.																		
99.	Lot 2 Sl. No. 1	Volume: II-B Section: I; Part B; Sub Sect: I General Specification & Design Criteria of Chimney – Civil & Structural Works	Page 3 of 28 Clause no. 1.02.00	General parameters of the chimney	<p>1. Following parameters may be arranged / furnished by the customer/consultant</p> <p>a) Flue gas composition</p> <p>b) Density at operating temperature</p> <p>c) Actual volumetric flow</p> <p>2. In case of wet stacks, flue gas pressure at chimney entry level is comes in the range of (-)20mmWC to (-)40mmWC and it is required to be considered in ID fan /booster fan selection.</p> <p>Hence, flue gas pressure at Chimney entry level cannot be considered as NIL. Customer / consultant to review and update</p>	<p>1. The following are the parameters:</p> <p>a) Flue gas composition @ chimney inlet:</p> <table border="1"> <tbody> <tr> <td>H2O</td> <td>Vol %</td> <td>12.54</td> </tr> <tr> <td>SO2</td> <td>Vol %</td> <td>0.01</td> </tr> <tr> <td>SO3</td> <td>Vol %</td> <td>0</td> </tr> <tr> <td>CO2</td> <td>Vol %</td> <td>14.33</td> </tr> <tr> <td>O2</td> <td>Vol %</td> <td>3.34</td> </tr> <tr> <td>N2</td> <td>Vol %</td> <td>69.78</td> </tr> </tbody> </table> <p>b) Flue gas density -1.102 kg/m3; Operating Temperature -50 °C</p> <p>c) Flue gas flow -2758744 m3/hr</p> <p>2. Noted. The additional pressure drop due to wet chimney to get excess draft is already considered in Booster fan design.</p>	H2O	Vol %	12.54	SO2	Vol %	0.01	SO3	Vol %	0	CO2	Vol %	14.33	O2	Vol %	3.34	N2	Vol %	69.78
H2O	Vol %	12.54																						
SO2	Vol %	0.01																						
SO3	Vol %	0																						
CO2	Vol %	14.33																						
O2	Vol %	3.34																						
N2	Vol %	69.78																						

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
					the same.	
100.	Lot 3 Sl. No. 1	NIT	1.2 (b), page 1 of 6	The MS flue can shall be of corrosion resistant steel type COR-TEN B of minimum 10mm thick. Top 10m length or length equal to 2 times flue diameter whichever is larger shall be provided using SS material confirming to AISI : 316L or BS: 1449.	Bidder request to also consider "ASTM A588 GRADE-B" in place of COR-TEN B material for MS flue can.	Tender Condition prevails.
101.	2.	Section 1 Part B of Volume II B	1.01.1 (Sub-section – I, page no. 2 of 28, 2 nd paragraph)	..... and erection of associated steel work and other chemicals on the completed structures.....	Bidder understands that other chemical means painting of structural surface.	Tender condition prevails.
102.	3.	Section 1 Part B of Volume II B	3.00.00 (Sub-section – I, page no. 12 of 28, 2 nd paragraph)	Ordinary Portland cement namely OPC 43 conforming to IS: 8112 (Latest revision) shall be used for construction.....	IS: 8112 has been withdrawn and replaced by IS: 269-2015.	Noted. IS: 269-2015 shall be followed in place of IS: 8112 wherever specified.
103.	4.	Section 1 part B of Volume II B	3.00.00 (Sub-section – I, page no. 12 of 28, 4 th paragraph)	..... plates for steel flue shall be CORTEN B steel conforming to IS 2062 having yield stress 250 MPa.	COR-TEN B steel does not conform to IS: 2062. It conforms to ASTM A588 GRADE-B. Hence, equivalent material conforming to ASTM A588 GRADE-B shall be permitted for steel flue of chimney.	Tender Condition prevails.
104.	5.	Section 1 part B of Volume II B	3.01.00 (Sub-section – II, page no. 7 of 15, 1 st paragraph)	At least three weeks before commencing any concreting in the work the bidder shall make trial mixes using samples of coarse aggregate, sand,	Please refer point no. 6 for query.	Tender Condition prevails.

NLCIL Sl. No.	Bidder Sl. No	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
				water and cement,.....		
105.	6.	Section II of Volume II A	1.3.0 (page no. 2 of 11)	Implementation schedule..... a. Test piles and load test 2 months from zero date	Requirement prior to submission of report of test piles are as follows: a. Approval of source for materials and approval of design mix – which will take minimum 6 weeks from zero date. b. Trial mix at site – which will take minimum 4 months after approval of design mix – to obtain the 28 days strength of trial mix. c. Load test on pile can be conducted only after completion of 28 days age of pile. Hence, minimum time required for completion of test pile and load test is 14 weeks. Bidder requests to accordingly modify the schedule.	Not acceptable. Tender Condition prevails.
106.	7.	Section II of Volume II A : Sub – section VI	3.01.00 (page no. 11 of 23)	Fabrication may be either shop fabricated of site fabricated.	May please be corrected as “Fabrication may either shop fabricated or site fabricated.”	Noted.
107.	8.	Section III of Volume II A	Annexure – 1, (page no. 12 of 16)	Acceptance criteria for sub- contractor: - ii) For civil & structural works: All civil & structural works related to chimney, shall	Bidder requests to allow engagement of sub- contractor for civil & structural works.	Not acceptable. Tender Condition prevails.

NLCIL Sl. No.	Bidder Sl. No.	Section/ Volume	Clause No./ Sheet No.	Specification Requirement	Pre-Bid Clarification	NLCIL/DCPL Reply
				be carried out by the successful bidder as per QR requirements by which the successful bidder got qualified.		

3. M/s. Bygging India Limited.

Sl. No.	Bidder Sl. No.	Ref. Clause of Tender Document	Existing Provision	Bygging Query	NLCIL/ DCPL Reply
108.	32	Volume-II B, Section –1 Part – A, Sub Section: IV Cement Concrete Clause No. 2.05.02 (iii)	The Crushed stone sand in general shall not be used for the following structures/facilities: - a) Structures constructed using slip form technology b) All internal & external plastering works. The structures where the slip form construction is envisaged the M-sand or Crushed stone sand may be used for casting its foundations only as they are not constructed using slip form Technology.	Crushed stone sand will be allowed for chimney construction as being allowed at the other places	Tender Condition prevails. Bidder is requested to follow Tender Condition.
109.	33	Volume-II B, Section –1 Part – A, Sub Section: VI Fabrication of Structural Steel work Clause No. 3.00 Workmanship	Fabrication: Fabrication may be either shop fabricated of Site fabricated.	It may be noted as: Fabrication may be either shop fabricated or Site fabricated.	Noted.
110.	34	Volume-II B, Section –1 Part – B, Sub Section: I General Specification & Design Criteria of Chimney Clause No.- 1.06 (iv) Workmanship	Liquid collectors shall be designed and developed experimentally using a physical model	Please allow use of FRP	Tender condition prevails. Bidder is requested to follow Tender Condition. Suitable alloy steel as per Cl. No. 1.07.00, Sec 1, Part B, Sub Sec 1, page 10 of 28, Vol II B only shall be used

Sl. No.	Bidder Sl. No.	Ref. Clause of Tender Document	Existing Provision	Bygging Query	NLCI L/ DCPL Reply
111.		Volume-II B, Section – 1 Part – B, Sub Section: I General Specification & Design Criteria of Chimney Clause No.- 1.06 (v) Workmanship	A common Nickel based alloy material storage/neutralizing tank for both the units of storage capacity of as per mechanical requirement of condensate from both the flues shall be provided complete with neutralizing chemicals dosing, mixing and preparation system. The neutralized condensate shall be pumped to common drain system by pumps as per mechanical requirement, complete with valves, piping and fittings, level control and monitoring etc. All the equipment, piping and Fittings in contact with the condensate shall be of suitable material for the operating duty. The condensate collection system in this package includes condensate from FGD outlet up to flue can top.	FGD outlet up to flue can top for Chimney only	Bidder's query is not clear. However, bidder to note that Tender condition prevails. Bidder is requested to follow Tender condition.
112.		Volume-II B, Section –1 Part – B, Sub Section: I General Specification & Design Criteria of Chimney Clause No.- 6.04 Foundation	Only PILE foundation shall be provided.	Type of the Foundation will be based on the design	Tender condition prevails. Only Pile foundation shall be provided. Bidder is requested to follow Tender Condition.
113.		Volume-II B Section – 1 Part – B, Sub Section: I General Specification & Design Criteria of Chimney Clause No.- 6.04 Foundation	The pile cap may be treated as raft and annular raft with hollow inside is not permitted. Pile cap diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12.	Please allow Annular raft if design permits	Not acceptable. Tender condition prevails. Bidder is requested to follow Tender Condition.
114.	33	Volume-II B, Section– 1 Part – B, Sub Section: I General Specification & Design Criteria of Chimney Clause No.- 6.05 Outer Platforms	Outer platforms shall be of RCC. It shall be provided as per Directorate of Air Routes & Aerodromes (DARA) Circular for locating Aviation Warning Lights and for other maintenance purposes. The platforms shall be equally spaced at a spacing of 40 m (maximum). Additional platforms for	The external platforms are not required as maintenance of aviation light can be done from inside. This is regular practice adopted by NTPC & other plant owners	Tender condition prevails. Bidder is requested to follow Tender Condition.

Sl. No.	Bidder Sl. No.	Ref. Clause of Tender Document	Existing Provision	Bygging Query	NLCI L/ DCPL Reply
			sampling ports, access doors, clean out doors etc. shall have to be provided as per requirements. Total nos. of external platforms will be 4 nos.(minimum).		

4. M/s. HADEK

NLCIL SI No.	Bidder SI. No.	Reference Section/Clause/ Sub Clause	Description /Provision in tender document	Hadek's Query	NLCIL/DCPL reply
115.	1.	Acceptance Criteria for Sub Vendors, Page 11 of 16 Vol. II-A/Section-III Engineering Services	<p>vii) (a) The Firm should be a manufacturer of Borosilicate Lining System or authorised supplier of the manufacturer (OEM) and should have supplied, erected/ supervised erection of Borosilicate Block Chimney Lining system for at least one (1) number of RCC chimney of minimum 150 Meters height with steel flue can in a power plant.</p> <p>(b) The above Borosilicate block Chimney Lining system should have completed satisfactory operation for a period of not less than one (1) year as on the original scheduled date of Tender opening.</p> <p>(c) The Bidder should furnish documentary evidence to prove (a) & (b) above by furnishing the following documents:</p> <p>i. Bidder shall furnish the PO copy / supporting documents of at least one (1) executed Contract as mentioned in 'a' above.</p> <p>ii. Corresponding certificate from owner for successful operation of 'borosilicate Glass block lining system' as mentioned in 'b' above indicating date of commissioning.</p>	<p>(1) Is it required for the chimney flue lining system to have a record of successful use under FGD Wet Stack (i.e. low temperature, water saturated, non-reheated) operating conditions? If yes, please indicate how many references and how many years of successful operation must be demonstrated.</p> <p>(2) Is it required for the chimney flue lining system to not allow any liquid re-entrainment at 18.3 m/s, or is it acceptable to allow minimal, but not significant re-entrainment of liquid condensate into the flue gas stream?</p> <p>(3) Are there any possible operating conditions where the flue gas velocity will be higher than 18.3 m/s? If yes, (a) please indicate how high the velocity would be and (b) if it is acceptable for re-entrainment to occur under such operating conditions?</p>	<p>Tender Condition prevails and is self explanatory.</p> <p>Tender Condition prevails and is self explanatory. Refer Cl. 1.07.00/Vol-II B Sec-I, Part-B, Sub Sec-I/ Page 7 of 28.</p> <p>Bidder's query doesn't have relevance to the technical specification of the bid document.</p>

NLCIL SI No.	Bidder SI. No.	Reference Section/Clause/ Sub Clause	Description /Provision in tender document	Hadek's Query	NLCIL/DCPL reply
116.	2.	Acceptance Criteria for Sub Vendors, Page 11 of 16 Vol. II-A/Section-III Engineering Services	NOTE: During the application of the Borosilicate Lining system, the sub vendor who is supplying the Borosilicate Lining system shall also supply sufficient number of skilled supervisors to assist the Application of the Borosilicate Lining system by the successful bidder. A separate QA plan towards this shall be furnished before starting of the works by the sub vendor for the approval of the owner.	(4) Is it acceptable for the lining system supplier to make incidental checks during the lining installation works, or is full time technical supervision of the installation works required? (5) In a previous (international) tender related to this project, NLC required that technical supervisors deputed by the lining system supplier should have a minimum 5 year experience in the use of the subject lining system. Is this requirement still valid for the current tender?	Tender Specification is self explanatory & very clear. Tender Condition prevails and is self explanatory. Refer Cl. 1.07.00 / Vol-II-B Sec-I, Part-B, Sub Sec-I / Page 9 & 10 of 28.


 18.07.2022
 For GENERAL MANAGER / CONTRACTS & IE

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021


Mechanical -DEVIATIONS

Bidder: M/s BHEL

Annexure-2.1

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL REPLY	Bidder's Reply	TCM Resolution
	Vol/Chapter/Clause/ Page	TS Requirement	Vol/Chapter/Clause/ Page	Deviation (or) Offer Details			
1.	General		Schedule F4 Deviation Schedule To Technical Specification	-	It is noted that the Bidder has not taken any deviation on stack elevator in the offer and the bidder completely complying with bid specification without any deviation. Bidder to confirm.	Shall be discussed during TCM	Bidder confirmed. NLCIL/DCPL Noted Point closed

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

COMMENTS ON WRITE-UP-Mechanical

Bidder: M/s BHEL

Annexure 2.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II B; Section-II	-			Bidder has not submitted any technical write-up of stack elevator. Bidder to confirm that the offer completely complying with the bid specification requirement.	Shall be discussed during TCM.	Bidder informed that the details shall be provided during execution of the contract as they shall be firmed after detailed engineering. However, the same shall be meeting the tender conditions/approval of the Purchaser. NLCIL/DCPL Noted Point closed

M/s NLCIL



M/s DCPL (Consultant)



M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

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COMMENTS ON WRITE-UP-Mechanical

Bidder: M/s BHEL

Annexure 2.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
2	Vol. -II B; Section-I, Part- B, Subsection-I, Cl.1.06.00-iv	Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), including the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in			Bidder to confirm the physical flow model study shall be carried out from absorber outlet to chimney and provide the necessary drain collection equipments and flow control device based on the physical flow model study results from absorber outlet to chimney will be in Bidder		Bidder noted and confirmed. NLCIL/DCPL noted Point closed

M/s NLCIL



M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu	
Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant	
Techno Commercial Meeting dated 18.01.2021	
COMMENTS ON WRITE-UP-Mechanical	
Bidder: M/s BHEL	Annexure 2.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
		the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to drain out to the ground before evaporation. For the model studies, sharing of the necessary			scope		

M/s NLCIL



M/s DCPL (Consultant)

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M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

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COMMENTS ON WRITE-UP-Mechanical

Bidder: M/s BHEL

Annexure 2.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
		input and result details with the FGD vendor shall be considered for reiteration of model study and finalizing the ducting and flue can design.					

M/s NLCIL



M/s DCPL (Consultant)



M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Comments on SPARES - Mechanical

Bidder: M/s BHEL

Annexure 2.3

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II B; Section-II, Annexure-II	Spares	Sl.No.11: Mandatory spares.	Elevator spares	Bidder to confirm to supply the mandatory spares as listed in the Tender Specification and shall furnish item wise price breakup for the same as per Table-3 / Schedule F-1. The line below the list. "The Applicable spares from the above list shall be supplied by M/s BHELPSSR" shall be deleted.	To be discussed in TCM	Refer S.No 2 Annexure 1 1 NLCIL/DCPL noted Point closed

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL.

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Comments on SUB-VENDOR LIST - Mechanical

Bidder: M/s BHEL

Annexure 2.4

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II A; Section-III Annexure-1	List of Sub-vendors-Mechanical equipment	Sl.No.13 : List of sub-vendors-Mechanical	Shall be provided during execution.	Bidder to furnish the Sub-Vendor list Stack elevator in editable format before the Techno-commercial meeting.	To be discussed in TCM	During the meeting M/s BHEL was informed to submit the Mechanical sub-vendor list in line with IS requirements on or before 25 01 2021 NLCIL/DCPL informed that the consolidated and categorized list of sub vendors will be

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu	
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Techno Commercial Meeting dated 18.01.2021	
Comments on SUB-VENDOR LIST - Mechanical	
Bidder: M/s BHEL	Annexure 2.4

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
							<p>communicated to the bidder separately.</p> <p>M/s BHEL noted and confirmed.</p> <p>NLCIL/DCPL Noted.</p>

M/s NLCIL



M/s DCPL (Consultant)



M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Mechanical - DATA SHEET

Bidder: M/s BHEL

Annexure 2.5

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II B; Section-II	-	SI.No.8.1: Technical Data sheet-Mechanical	Shall be submitted after the award of contract during execution. Technical detail depend upon the make of the selected equipment.	Bidder has not submitted the technical data sheet for stack elevator. Bidder to confirm that the offer completely complying with the bid specification requirement	Shall be discussed during TCM.	Bidder informed that the details shall be provided during execution of the contract as they shall be firmed after detailed engineering. However, the same shall be meeting the tender conditions/approval of the Purchaser. NLCIL/DCPL Noted Point closed

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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COMMENTS ON DRAWINGS - Mecanical

Bidder: M/s BHEL

Annexure 2.6

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II B; Section-II	-	Sl.No.10.2: Drawings	Shall be submitted after the award of contract during execution. Technical detail depend upon the make of the selected equipment.	Bidder has not submitted stack elevator drawings along with the offer. Bidder to confirm compliance to the Technical specification and Tender drawings.	Shall be discussed during TCM	Bidder informed that the details shall be provided during execution of the contract as they shall be firmed after detailed engineering. However, the same shall be meeting the tender conditions/approval of the Purchaser. NLCIL/DCPL Noted Point closed

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dated: 18.01.2021

Electrical (Annexure-4.1)

DEVIATIONS

Bidder: M/s Bharat Heavy Electrical Limited (BHEL)

Annexure-4.1

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL REPLY	Bidder's Reply	TCM Resolution
	Vol/Chapter/Clause/Page	TS Requirement	Vol/Chapter/Clause/Page	Deviation (or) Offer Details			
1.	General		Schedule F4 : Deviation Schedule To Technical Specification	-	It is noted that the Bidder has not taken any deviation in the offer and the bidder completely complying with bid specification without any deviation. Bidder to confirm.	BHEL confirms compliance to tender conditions read in conjunction with amendments/ resolution to post bid discussions/ subsequent amendments/ approvals.	NLCIL / DCPL Noted Point Closed.

M/s NLCIL



M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined BI-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dated: 18.01.2021

Electrical (Annexure-4.2)

COMMENTS ON WRITE-UP

Bidder: M/s BHEL

Annexure 4.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II B; Section-III	-	Sl.No.10.1: Technical Write-up	Shall be submitted after the award of contract during execution. Technical detail depend upon the make of the selected equipment.	Bidder has not submitted an technical write-up. Bidder to confirm that the offer completely complying with the bid specification requirement.	To be discussed in TCM	M/s BHEL confirmed that the details shall be provided during execution of the contract as they shall be firmed after detailed engineering. However, the same shall be meeting the tender conditions/approval of the Purchaser. NLCIL/DCPL Noted. Point closed.
2.	Vol-IB, Section-2, Cl. 2.6 (i), page 20 of	Construction Power.	Schedule F5, Construction Power	500 kVA for 21 months.	Construction Power Shall be provided at 415V	To be discussed in TCM	M/s. BHEL Confirms <i>noted compliance with Tender and specification: Confirmed</i>

M/s NLCIL

M/s DCPL (Consultant)

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M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dated: 18.01.2021

Electrical (Annexure-4.2)

COMMENTS ON WRITE-UP

Bidder: M/s BHEL

Annexure 4.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
	158		Requirement		for the purpose of erection construction under the contract at one point. Bidder to confirm compliance.		NLCIL/DCPL Noted. Point Closed.
3.		Quality Assurance Plan	Sl.No.14.0	Quality Assurance Plan	Bidder to submit the detailed quality assurance plan (MQP, Field quality plan, etc.) for each equipment and system separately during post award	To be discussed in TCM	M/s. BHEL confirms to submit the detailed quality assurance plan (MQP, Field quality plan, etc.) for each equipment and system separately during post award engineering for Owner's review and approval.

M/s NLCIL

M/s DCPL (Consultant)

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M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dated: 18.01.2021

Electrical (Annexure-4.2)

COMMENTS ON WRITE-UP

Bidder: M/s BHEL

Annexure 4.2

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
					engineering for Owner's review and approval. Bidder to confirm compliance.		NLCIL/DCPL Noted. Point Closed

M/s NLCIL



M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dt: 18.01.2021

Electrical (Annexure-4.3)

Comments on SPARES

Bidder: M/s Bharat Heavy Electrical Limited (BHEL)

Annexure 4.3

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specificati on details	Bid ref.	Bid details			
1.	Vol. -II B, Section-II, Annexure-II and Section-III, Annexure-A	Spares	Sl.No.11 : Mandatory spares.	Chimney spares and Elevao spares	Bidder to confirm to supply the mandatory spares as listed in the Tender Specification and shall furnish item wise price breakup for the same as per Table-3 / Schedule F-1. <i>The line below the list. "The Applicable spares from the above list shall be supplied by M/s BHELPSSR" shall be deleted.</i>	To be discussed in TCM	Refer S No. 2 of Annexure 1 1 NLCIL/DCPL noted. Point closed.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu	
Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined BI-flue can arrangement for FGD Plant	
TECHNO COMMERCIAL MEETING Dated: 18.01.2021	
Electrical (Annexure-4.4)	
Comments on SUB-VENDOR LIST	
Bidder: M/s Bharat Heavy Electrical Limited (BHEL)	Annexure 4.4

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II A, Section-III	List of Sub-vendors-Electrical equipment	Sl.No.13 List of sub-vendors-Electrical	Shall be provided during execution,	<p>Bidder to furnish the Sub-Vendor list for class-I and Class-II electrical items mentioned in the bid specification in editable form before the Techno-commercial meeting.</p> <p>Classification of sub vendors into category-I and category-II shall be intimated by the purchaser.</p>	To be discussed in TCM	<p>During the meeting M/s BHEL was informed to submit the Electrical sub-vendor list in line with TS requirements on or before 25.01.2021.</p> <p>NLCIL/DCPL informed that the consolidated and categorized list of sub vendors will be communicated to</p>

M/s NLCIL


M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu	
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TECHNO COMMERCIAL MEETING Dated: 18.01.2021	
Electrical (Annexure-4.4)	
Comments on SUB-VENDOR LIST	
Bidder: M/s Bharat Heavy Electrical Limited (BHEL)	Annexure 4.4

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
							the bidder separately M/s BHEL noted and confirmed NLCIL/DCPL Noted.

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dated: 18.01.2021

ELECTRICAL (Annexure-4.5)

Comments on DATA SHEET

Bidder: M/s Bharat Heavy Electrical Limited (BHEL)

Annexure 4.5

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1	Vol. -II B, Section-III	-	SI.No.8.2 Technical Data sheet-Electrical	Shall be submitted after the award of contract during execution. Technical detail depend upon the make of the selected equipment.	Bidder has not submitted the technical data sheet. Bidder to confirm that the offer completely complying with the bid specification requirement.	Shall be discussed during TCM.	M/s BHEL confirmed that the details shall be provided during execution of the contract as they shall be firmed after detailed engineering. However, the same shall be meeting the tender conditions/approval of the Purchaser. NLCIL/DCPL Noted. Point closed.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

TECHNO COMMERCIAL MEETING Dated : 18.01.2021

Electrical (Annexure-4.6)

COMMENTS ON DRAWINGS

Bidder: M/s Bharat Heavy Electrical Limited (BHEL)

Annexure 4.6

S.No	TENDER SPECIFICATION REFERENCE		OFFER REFERENCE		NLCIL/DCPL Comments	Bidder's Reply	TCM RESOLUTION
	Vol. / Clause/ Page no	Specification details	Bid ref.	Bid details			
1.	Vol. -II B; Section-III	-	Sl.No.10.2: Drawings	Shall be submitted after the award of contract during execution. Technical detail depend upon the make of the selected equipment.	Bidder has not submitted any Electrical drawings along with the offer. Bidder to confirm compliance to the Technical specification and Tender drawings.	Shall be discussed during TCM.	M/s BHEL confirmed that the details shall be provided during execution of the contract as they shall be firmed after detailed engineering. However, the same shall be meeting the tender conditions/approval of the Purchaser. NLCIL/DCPL Noted. Point closed.

M/s NLCIL



M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.1)

DEVIATION

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.1

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Vol/Clause/ Page No.	Deviation (or) Offer Details			
1.	Volume II-A/ Section-III/Annexure-1(e)	Purchaser may consider However, price advantage if any, arising out of inclusion of new sub vendors will be passed on to the Purchaser.	Sl. No.1 of Schedule-F4 (Deviation Schedule to Technical Specification)	Please delete "However, price advantage if any, arising out of inclusion of new sub vendors will be passed on to the Purchaser."	Not acceptable. Tender condition prevails. M/s. BHEL shall withdraw the deviation taken. M/s BHEL to note and confirm.	To be discussed in TCM	During the meeting, M/s BHEL withdrew the deviation taken and confirmed compliance to Tender specification NLCIL/DCPL noted. Point Closed.
2.	Volume II-A/ Section-II/ Clause No 1.3.0/ Page 2 of 11		Sl. No.2 of Schedule-F4 (Deviation Schedule to Technical Specification)	1.Geo-Technical approved drawings (Minimum 3 months required for investigation and approval of drawings) is required for approval of Test pile drawings. But Geotechnical	Not acceptable. Tender condition prevails. M/s. BHEL shall withdraw the deviation taken. M/s BHEL to note	To be discussed in TCM	During the meeting M/s BHEL withdrew the deviation taken and confirmed compliance to Project duration of 21 months

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.1)

DEVIATION

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.1

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Vol/Clause/ Page No.	Deviation (or) Offer Details			
				investigation is not included in the implementation schedule. 2. Borosilicate lining which is a time consuming and critical major work will take minimum three months to execute. But the same is not included in the implementation schedule. The above two will lead to time and cost overruns.	and confirm.		NLCIL/DCPL noted Point Closed.
3.	General		Sl. No.3 of Schedule-F4 (Deviation	It is understood that multiple brand of Cements can be used	Not acceptable. Tender condition prevails.	To be discussed	During the meeting, NLCIL/ DCPL informed that the

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.1)

DEVIATION

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.1

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Vol/Clause/ Page No.	Deviation (or) Offer Details			
			Schedule to Technical Specification)	for Construction of Chimney Shell.	M/s. BHEL shall withdraw the deviation taken. M/s BHEL to note and confirm.	in TCM	request of M/s BHEL is not acceptable to NLCIL/DCPL Hence, M/s BHEL withdrew the deviation taken and confirmed compliance to Tender specification with Price Implication. NLCIL/DCPL noted. Point Closed.

Note: If any deviation has marked other than F4 schedule, those points will not be considered as the deviation. -TCM Resolution:

During the meeting M/s BHEL noted and confirmed.

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.2)

WRITE UP

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.2

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Bid Ref.	Bid Details			
1.	-	-	-	Bidder has not furnished Civil & Structural write-up in the Bid document.	Bidder shall confirm that their offer is strictly in line with the Tender Specification Volume-II & Tender drawings for Civil, Architectural & Structural works. M/s BHEL to note & confirm.	BHEL confirms compliance to tender conditions read in conjunction with amendments/ resolution to post bid discussions/ subsequent amendments/ approvals.	Where ever deviations agreed by NLCIL/DCPL in Annexure for Deviation under the respective discipline, alone is accepted as deviation. No other deviation elsewhere in the bid shall be considered. M/s BHEL noted and confirmed. NLCIL/DCPL noted. Point closed.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.2)


WRITE UP

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.2

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Bid Ref.	Bid Details			
2.	Volume-1A/ Schedule F5	Requirements of the Contractor at site	Schedule F5	Bidder has sought land for Site fabrication & construction activities at site put together 10,000 Sq. m.	<p>Bidder to note that sufficient land as per availability shall be provided (inside the plant boundary and/or land outside the plant boundary) to the successful bidder subject to availability of land.</p> <p>M/s BHEL to note and confirm.</p>	To be discussed in TCM	<p>During the meeting NLCIL/DCPL requested to follow Cl.2.7.1 i) Vol-1B/ Section-2/ Page 21 of 158 NTPL informed that the land as requested by BHEL will be allotted within the Plant boundary and may be in more than 1 (one) location as per availability.</p> <p>M/s BHEL agreed to follow Tender specification.</p> <p>NLCIL/DCPL noted</p>

M/s NLCIL

 M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.2)

WRITE UP

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.2

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Bid Ref.	Bid Details			
							Point closed.
3.	Volume-IA/ Schedule F5	Requirements of the Contractor at site	Schedule F5	Bidder has sought the requirement of Construction water at site as 60 cubic meters per day for 21 months.	Bidder to note that sufficient construction water to meet the construction requirements shall be provided by the owner. M/s BHEL to note and confirm.	To be discussed in TCM	During the meeting NLCIL/DCPL informed that 'sufficient construction water to meet the construction requirements shall be provided by the owner as per Tender Specification'. M/s BHEL noted and confirmed. NLCIL/DCPL noted Point closed
4.	Volume-IA/ Schedule	Contractor's Resource	Schedule F6	Bidder has not furnished resource	However, M/s BHEL shall confirm that the	To be discussed	During the meeting M/s BHEL noted and

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.2)

WRITE UP

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.2

Sl. No	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement	Bid Ref.	Bid Details			
	F6	Deployment Schedule		deployment schedule.	MANPOWER requirement is in line with the project time schedule, L1 PERT & depending upon the peak Civil activities at site. M/s. BHEL shall supply additional manpower & machinery depending upon the field requirement. M/s BHEL to note and confirm.	in TCM	confirmed that the 'MANPOWER requirement is in line with the project time schedule. L1 PERT & depending upon the peak Civil activities at site M/s. BHEL shall supply adequate manpower & machinery depending upon the field requirement'. NLCIL/DCPL noted. Point closed.

M/s NLCIL

M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu	
Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant	
Techno Commercial Meeting dated 18.01.2021	
Civil (Annexure-5.2)	
WRITE UP	
Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)	ANNEXURE 5.2

Note:

1. Bidder may please note that except deviation points accepted by Owner, the tender specification prevails and binding to the bidder. TCM Resolution: During the meeting, M/s BHEL noted and confirmed.
2. In case of any mismatch /discrepancies/contradiction between bidder's technical write-up/ offer and tender specification, the specification will prevail. TCM Resolution: During the meeting, M/s BHEL noted and confirmed.
3. In case of any mismatch /discrepancies/contradiction in tender specification, the stringent will prevail. TCM Resolution: During the meeting, M/s BHEL noted and confirmed.

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.3)

SUB VENDORS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.3

Sl. No	Tender Specification Reference		As Per Bid Document	NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement				
1.	Vol-IIA/ Section-III/ Annexure-1/ Page 14 -16 of 16	List of Sub Vendors - Civil & Structural Supply Portion	M/s BHEL have furnished a Partial Civil sub vendor list.	For some of the Civil supply portion items M/s BHEL have mentioned as ' <i>shall be provided during execution</i> ' which is not acceptable to NLCIL/DCPL. For these items also M/s BHEL shall submit proposed sub-vendors and re-submit the Civil sub vendor list with in one week time to NLCIL/ DCPL as stipulated in the Tender specification vide Vol-IIA/Section-III/ Annexure-1/ Page 14 - 16 of 16, to enable NLCIL / DCPL to categorise the list into Category I / Category II in line with Vol IIA, Section-III, Annexure-1/ General (d)/ Page 9 of 16.	To be discussed in TCM	<p>During the meeting M/s BHEL was informed to re-submit the Civil sub-vendor list in line with TS requirements on or before 25.01.2021.</p> <p>NLCIL/DCPL informed that the consolidated and categorised list of sub vendors will be communicated to the bidder separately.</p> <p>M/s BHEL noted and confirmed.</p> <p>NLCIL/DCPL Noted.</p>

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.3)


SUB VENDORS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.3

Sl. No	Tender Specification Reference		As Per Bid Document	NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement				
				M/s BHEL to confirm.		
				<p>M/s BHEL has proposed sub vendors for Wind tunnel test for chimney which is not specified in the sub vendor list of tender specification. Hence this shall be deleted from the sub vendor list by BHEL.</p> <p>However, in respect of agency for conducting wind tunnel test, M/s BHEL shall follow Vol-IIB/Sec-I Part-B/Sub Sec-I/ Cl. 1.01.D.</p> <p>M/s BHEL to note and confirm.</p>	Noted with price implication.	<p>During the meeting M/s BHEL noted and confirmed to the TS requirement without any Price implication. M/s BHEL agreed to carryout the wind tunnel test for chimney based on TS requirements.</p> <p>NLCIL/DCPL noted.</p> <p>Point closed.</p>

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.4)

DRAWINGS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.4

Sl. No	Tender Specification Reference		As Per Bid Document	NLCIL/DCPL Comments	Bidder's Reply	TCM Resolution
	Vol/Clause/ Page No.	TS Requirement				
1.	-	CIVIL TENDER DRAWINGS	M/s BHEL have not furnished any Civil tender drawings along with their Bid offer.	<p>Noted. However, Bidder is requested to confirm that all the drawings/ system is offered strictly in compliance with tender specification except the deviation points accepted by Owner.</p> <p>In case of any mismatch / discrepancies/ contradiction between bidder's drawings and tender specification, the technical specification will prevail.</p> <p>In case of any mismatch / discrepancies/ contradiction in tender specification, the stringent will prevail.</p> <p>M/s BHEL to note and confirm.</p>	Shall be discussed during TCM.	<p>During the meeting M/s BHEL noted and confirmed to the NLCIL/DCPL comments.</p> <p>NLCIL/DCPL noted.</p> <p>Point closed.</p>

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Details	Bidders reply	TCM Resolution
1.	Deviations accepted in one place are also applicable for same stipulation elsewhere in the specification. Bidder is requested to confirm.	Confirmed	NLCIL/DCPL noted the reply furnished by the bidder. Point closed.
2.	Bidder is requested to confirm that their offer is for the complete scope as per Tender specification. Other than the agreed deviations, the bidder confirms to Technical specification requirements, tender drawings and supplies the materials and services as per the scope to meet system requirement.	BHEL confirms compliance to tender conditions read in conjunction with amendments/ resolution to post bid discussions/ subsequent amendments/ approvals.	NLCIL/DCPL noted the reply furnished by the bidder. Point closed.
3.	As the bidder has not taken any deviation to the time schedule, Bidder is requested to confirm the time schedule as per tender specification.	Confirmed	NLCIL/DCPL noted the reply furnished by the bidder. Point closed.

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

4.	<p>Bidders should strictly comply with the material specified in tender specification. In case bidder is proposing alternate material, [wherever specifically allowed in tender specification]; bidder is requested to establish with supporting document and evidence, that his proposed material is 'at least equivalent or superior' to that mentioned in tender specification.</p> <p>Bidder's explanation and justification should meet the entire satisfaction and full acceptance of Owner/ Consultant.</p>	<p>BHEL confirms compliance to tender conditions read in conjunction with amendments/ resolution to post bid discussions/ subsequent amendments/ approvals</p>	<p>NLCIL/DCPL noted the reply furnished by the bidder.</p> <p>Point closed.</p>
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Enclosure-5.5, Revised Technical specification (TS) Requirement:

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
1.	Volume: II-B/ Section: I; Part B; Sub Section: I/ Cl. 1.07.00 / 10 of 28	The material of gutter including drain and base plates shall be made of suitable alloy steel to withstand design operating environment.	The material of gutter including drain and base plates shall be made of suitable alloy steel (C276) to withstand design operating environment.	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement with Price Implication. NLCIL/DCPL noted.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
					Point closed.
2.	Volume: II-B/ Section: I; Part B; Sub Section: I/ Cl. 1.01.00 / 3 of 28 Volume: II-B/ Section: I; Part B; Sub Section: I/ Cl. 4.01.03 / 13 of 28	Wind Tunnel Study shall be conducted in any one of the following approved Lab/Institute - SERC-Chennai, IISC-Bangalore & IIT-Kanpur and the study report shall be got approved by the Purchaser / Consultant.	Wind Tunnel Study shall be conducted in any one of the following approved Lab/Institute - SERC-Chennai or IIT-Kanpur and the study report shall be got approved by the Purchaser / Consultant.	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement Without any Price Implication. NLCIL/DCPL noted. Point closed.
3.	Volume: II-B Section: I; Part C; Sub Section: I/ Cl. 2.00.00/Page 1 of 19	- New clause added	The successful bidder shall carryout the following Geotechnical Investigation as deemed fit: a) 3 no. Bore holes up to 30 m depth below ground level irrespective of soil/rock strata	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement without any Price Implication. NLCIL/DCPL noted.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
			<p>encountered.</p> <p>b) Laboratory tests (as specified) on soil and rock samples collected from the bore holes.</p> <p>c) Chemical analysis of water (2 nos.) and sub soil samples.</p> <p>d) 2 no. ERT tests.</p> <p>e) 1 no. Cross hole shear wave test.</p> <p>f) 2 no. Field CBR tests and two laboratory CBR tests.</p> <p>The above list is not exhaustive. In case, the bidder feels that the additional tests are required; he/she is at liberty to carryout such additional tests without any additional cost to the owner.</p>		Point closed.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined BI-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
			Also refer Vol-II B Sec-II Part A/ Sub sec-I.		
4.	Volume: II-B Section: I; Part A; Sub Section: I/ Cl. 1.00.00 Scope	- New clause added	Note: This section is a general guideline for Geo-technical Investigation covering all general tests in soil and rock. However, the successful bidder shall carryout the following Geotechnical Investigation as deemed fit: a) 3 no. Bore holes up to 30 m depth below ground level irrespective of soil/rock strata encountered. b) Laboratory tests (as specified) on soil and rock samples collected from the bore holes. c) Chemical analysis of water (2	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement without any Price Implication. NLCIL/DCPL noted. Point closed.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined BI-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
			<p>nos.) and sub soil samples. d) 2 no. ERT tests. e) 1 no. Cross hole shear wave test. f) 2 no. Field CBR tests and two laboratory CBR tests.</p> <p>The above list is not exhaustive. In case, the bidder feels that the additional tests are required; he/she is at liberty to carryout such additional tests without any additional cost to the owner.</p>		
5.	Volume: II-B/ Section: I; Part A; Sub Section: V/ Cl. 3.02.00/page 7&8 of 22	<p>C) Lateral Capacity</p> <p>The Lateral capacity of single pile, at this site, will be considered as the minimum of the following:-</p>	<p>C) Lateral Capacity</p> <p>Lateral pile capacity assessed by the successful contractor .....decided by the contractor & purchaser.</p>	Noted with price implication.	During the meeting NLCIL / DCPL informed that the existing TS requirements in respect of the Lateral capacity shall prevail.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
		i) 5% of their respective compressive capacity of pile ii) Lateral pile capacity assessed by the successful contractor .....decided by the contractor & purchaser.			M/s BHEL Noted and confirmed to existing TS requirement without any Price Implication. NLCIL/DCPL noted. Point closed.
6.	Vol. II-B, Section 1, Part B, Sub Section 1, Cl. 1.06.00.i), Page No. 4 of 28	Treated flue .....2 mm thick Titanium sheet. The design .....design guide.	Treated flue .....2 mm thick Titanium sheet (Grade 2 as per ASME SB265). The design design guide.	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement without any Price Implication. NLCIL/DCPL noted. Point closed.
	Vol. II-B, Section 1, Part B, Sub Section 1, Cl.	The insulation .....2mm thick Titanium/ C276 sheet cladding carried out.	The insulation .....2mm thick Titanium (Grade 2 as per ASME SB265) sheet cladding carried out.		

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
	1.06.00.vii), Page No. 6 of 28				
7.	Volume: II-B Section: I; Part B; Sub Section: I/ Cl. 6.01.00 (7) / 17 of 28	Openings in the shell .....not more than 30° subtended at the center of the concrete shell. The total plan area more than 15% of the plan area	Openings in the shell .....not more than 45° subtended at the center of the concrete shell. The total plan area more than 20% of the plan area	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement without any Price Implication. NLCIL/DCPL noted. Point closed.
8.	Volume: II-B Section: I; Part A; Sub Section: I/ Cl. 3.01.00 / 5 of 26	Where possible.....when directed by the Engineer.	This Paragraph stands deleted.	-	During the meeting M/s BHEL noted and confirmed to the revised TS requirement. NLCIL/DCPL noted. Point closed.

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
9.	General (Wherever applicable)	IS 8112	IS 269 (Latest revision)	-	During the meeting M/s BHEL noted and confirmed to the revised TS requirement. NLCIL/DCPL noted. Point closed.
10.	Volume: II-B Section: I; Part A; Sub Section: VI/ Cl. 3.01.00 / 11 of 23	Fabrication: Fabrication may be either shop fabricated or Site fabricated	Fabrication: Fabrication may be either shop fabricated or Site fabricated	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement without any Price Implication. NLCIL/DCPL noted. Point closed.
11.	Volume: II-B Section: I; Part B; Sub Section:	A common Nickel based alloy material of suitable material for the operating	The condensate collection system in this package includes condensate from FGD outlet up to flue can top.	-	During the meeting M/s BHEL noted and confirmed to the revised TS requirement

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Techno Commercial Meeting dated 18.01.2021

Civil (Annexure-5.5)

COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
	I/ Cl. 1.06.00 (v) / 5 of 28	duty. The condensate collection system in this package includes condensate from FGD outlet up to flue can top.	The condensate from the flue cans and FGD outlet duct to chimney shall be connected to the condensate collection tank which only is in the Purchaser's scope. However the condensate downcomer drain pipe from the chimney to the collection tank is in the scope of the Additional Chimney contractor. (The condensation collection tank is in the scope of Purchaser).		with Price implication, NLCIL/DCPL noted. Point closed.
12.	Volume: II-B Section: I; Part B; Sub Section: I/ Cl. 6.01.00 (7) / 17 of 28	Puddle Flange <ul style="list-style-type: none"> Puddle flange located at the bottom of soot hopper shall be lined with High nickel alloy material for protection from acidic ash. 	This sentence stands deleted	-	During the meeting, M/s NLCIL/DCPL clarified that the puddle flange requirement at the bottom of flue can in the wet chimney doesn't arise, since there will not be dry ash

M/s NLCIL

M/s DCPL (Consultant)

M/s BHEL

NLC Tamilnadu Power Ltd. (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

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Civil (Annexure-5.5)


COMMON POINTS

Bidder: M/s Bharat Heavy Electricals Limited. (BHEL)

ANNEXURE 5.5

Sl. No.	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
					accumulation. M/s BHEL noted and confirmed to the revised TS requirement with Price implication . NLCIL/DCPL noted Point closed

M/s NLCIL


M/s DCPL (Consultant)


M/s BHEL

ANNEXURE - I

NLC TAMILNADU POWER LIMITED (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Price Implication - Commercial & Technical

Bidder: M/s. Bharat Heavy Electricals Limited (BHEL)

Deviation						Annexure 5.1		
Sl. No.	Sl. No Ann. 5.1	Tender Specification Reference		Offer Reference		NLCIL/DCPL Reply	Bidder's Reply	TCM Resolution
		Vol/Clause / Page No.	TS Requirement	Vol/Clause/ Page No.	Deviation (or) Offer Details			
3.	3	General	-	Sl. No.3 of Schedule-F4 (Deviation Schedule to Technical Specification)	It is understood that multiple brand of Cements can be used for Construction of Chimney Shell.	Not acceptable. Tender condition prevails. M/s. BHEL shall withdraw the deviation taken. M/s BHEL to note and confirm.	To be discussed in TCM	During the meeting, NLCIL/ DCPL informed that the request of M/s BHEL is not acceptable to NLCIL/DCPL. Hence, M/s BHEL withdrew the deviation taken and confirmed compliance to Tender specification with Price Implication. NLCIL/DCPL noted. Point Closed.

Annexure-5.5

Enclosure-5.5, Revised Technical specification (TS) Requirement:

Sl. No	Sl. No. in Ann-5.5 (Enclosure)	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
4.	1	Volume: II-B/ Section: I; Part B; Sub Section:	The material of gutter including drain and base plates shall be made of	The material of gutter including drain and base plates shall be made of suitable alloy steel (C276)	Noted with price implication.	During the meeting M/s BHEL noted and confirmed to the revised TS requirement with Price Implication.

ANNEXURE - I

NLC TAMILNADU POWER LIMITED (NTPL 2x500 MW Project), Tuticorin, Tamilnadu

Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant

Price Implication - Commercial & Technical

Bidder: M/s. Bharat Heavy Electricals Limited (BHEL)

Annexure-5.5

Enclosure-5.5, Revised Technical specification (TS) Requirement:

Sl. No	Sl. No. in Ann-5.5 (Enclosure)	Vol/Chapter/Clause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
		I/ Cl. 1.07.00 / 10 of 28	suitable alloy steel to withstand design operating environment.	to withstand design operating environment.		NLCIL/DCPL noted. Point closed.
5.	11	Volume: II-B Section: I; Part B; Sub Section: I/ Cl. 1.06.00 (v) / 5 of 28	A common Nickel based alloy material of suitable material for the operating duty. The condensate collection system in this package includes condensate from FGD outlet up to flue can top.	The condensate collection system in this package includes condensate from FGD outlet up to flue can top. The condensate from the flue cans and FGD outlet duct to chimney shall be connected to the condensate collection tank which only is in the Purchaser's scope. However the condensate downcomer drain pipe from the chimney to the collection tank is in the scope of the Additional Chimney contractor. (The condensation collection tank is in the scope of Purchaser).	-	During the meeting M/s BHEL noted and confirmed to the revised TS requirement with Price implication. NLCIL/DCPL noted. Point closed.
6.	12	Volume: II-B Section: I; Part B; Sub Section: I/ Cl. 6.01.00	Puddle Flange • Puddle flange located at the bottom of soot	This sentence stands deleted	-	During the meeting, M/s NLCIL/DCPL clarified that the puddle flange requirement at the bottom of flue can in the wet chimney doesn't

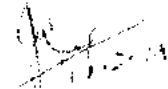
ANNEXURE - I

NLC TAMILNADU POWER LIMITED (NTPL 2x500 MW Project), Tuticorin, Tamilnadu
Construction of One RCC Additional Chimney of 150 M height with Borosilicate lined Bi-flue can arrangement for FGD Plant
Price Implication - Commercial & Technical
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Annexure-5.5

Enclosure-5.5, Revised Technical specification (TS) Requirement:

Sl. No	Sl. No. in Ann-5.5 (Enclosure)	Vol/Chapter/Cause/ Page	Existing TS Requirement	Revised TS Requirement	Bidder's Reply	TCM Resolution
		(7) / 17 of 28	hopper shall be lined with High nickel alloy material for protection from acidic ash.			arise, since there will not be dry ash accumulation. M/s BHEL noted and confirmed to the revised TS requirement with Price implication. NLCIL/DCPL noted. Point closed.



for General Manager/Contracts & IE



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**

SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-490-620-C002

VOLUME : IIB

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2X500 MW NTPL TUTICORIN CHIMNEY PACKAGE

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – D GENERAL TECHNICAL REQUIREMENTS

(RCC CHIMNEY)

**SPECIFICATION NO. PE-TS-490-620-C002
REV-00**



Bharat Heavy Electricals Limited

**Project Engineering Management
Power Sector, PPEI BUILDING, Plot No-25
SECTOR 16A, NOIDA-201301, UP**



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**
SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-490-620-C002
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PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.



**TITLE: 2X500 MW NTPL TUTICORIN CHIMNEY
PACKAGE**

SPECIFICATIONS FOR RCC CHIMNEY

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SECTION DESCRIPTION

Section-C SPECIFIC TECHNICAL REQUIREMENTS

**Section-D SPECIFICATION FOR CIVIL, STRUCTURAL
AND ARCHITECTURAL WORKS**

Sub-section D24: Quality Assurance & Inspection

Sub-section D25: RCC stack

Sub-section D26: Borosilicate glass block lining system



TITLE:

QUALITY ASSURANCE TESTS AND
INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024

VOLUME - IIB

SECTION - D

SUB SECTION- D24

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VOLUME: II B

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QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

QUALITY ASSURANCE TESTS AND INSPECTION

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QUALITY ASSURANCE TESTS AND INSPECTION

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test		<p>* For Test at S.No. 1, 2, 6 & 7 frequency of test shall be one in every 2000 M³ for each type & source of fill material. # Frequency of test for Sr. No. 3, 4 & 5 shall be one in every 5000 M³ for each type & source of fill material. @ For foundation filling, one for every 10 foundations for each compacted layer. However for heavily loaded foundations, each layer shall be tested. For area filling, one for every 1000 M² area for each compacted Layer. Note: The contractor shall include provision for setting up testing laboratory with all apparatus and equipments necessary for carrying out field tests.</p>	
All tests as per Indian/International STDS	11	Y	Y
Dry Density by Proctor Needle Penetration @	10	-	Y
Relative Density Index @	9	-	Y
Dry Density by core cutter/sand display cut @	8	-	Y
Moisture Content *	7	Y	-
STD Proctor Test *	6	Y	-
Chemical Analysis #	5	Y	-
Free Swell Index #	4	Y	-
Shrinkage Limit #	3	Y	-
Liquid Limit & Plastic Limit *	2	Y	-
Grain Size Analysis *	1	Y	-
Test Requirements		1. EARTH WORK a) Earth Fill Material (Before Compaction) b) Earth Fill Material (After Compaction)	
Item/Components			



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CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test		* Quantum of check for test at Sr. No 1 & 2 shall be one per 100 m ³ or part thereof or change of source whichever is earlier.	# To be done every day before start of work.	Note: For test at Sr. No. 3, 4, 5, 6, 7, 8, 9, 11 & 12 once per source. For remaining as per IS Code.			
All tests as per IS-Codes	21	Y	Y	Y			
Rebound Hammer Test	20	-	-	Y			
Cement Content	19	-	-	Y			
W.C. Ratio	18	-	-	Y			
Slump and Compaction Factor	17	-	-	Y			
Harmful substance	16	-	-	Y			
pH Value	15	-	-	Y			
Crushing Strength	14	-	-	Y			
Setting Time	13	-	-	Y			
Petrographic Exam.	12	Y	Y	-			
Silt, Clay and organic impurities	11	-	Y	-			
Bulkage	10	-	Y #	-			
Mortar Making Properties	9	-	Y	-			
Deleterious Matl. And MICA content	8	Y	Y	-			
Flakiness Index	7	Y	-	-			
Reaction with Alkali	6	Y	Y	-			
Soundness	5	Y	Y	-			
Mech. Properties	4	Y	-	-			
Specific Gravity, Density, Void, Absorption	3	Y	Y	-			
Moisture Content	2	Y *	Y #	-			
Particle Size and Shape Sieve analysis	1	Y *	Y *	-			
Test Requirement Checks	Item/Components	2. CONCRETING	a) Coarse Aggregate	b) Fine Aggregate/Sand	c) Cement	d) Water	e) Concrete



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CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test	* These tests shall be carried out, in case of doubt regarding grade of concrete due to poor workmanship based on results of cube strength.														
Load test on structures as per IS: 456 & core test	.	.	.	.	.	.	.	.	.	.	.	Y*	.	.	.
Water tightness test as per IS: 3370 & Is: 6494	.	.	.	.	Y	.	.	Y	.	.	.	.	.	.	.
All Tests as per Indian/International Standard/BHEL Tech. Spec.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	.	.	Y
Core Test	.	.	.	.	.	.	.	.	.	.	.	Y	.	Y	.
Ultrasonic Test	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verticality all	.	.	.	.	.	Y	.	.	.	.	.	.	.	Y	.
Work man ship	.	.	.	.	.	Y	.	.	.	.	.	.	.	.	.
Water Retentivity as per IS: 2250	.	.	.	.	Y	.	.	.	.	.	.	.	.	Y	.
Consistency as per IS: 2250	.	.	.	.	Y	.	.	.	.	.	.	.	.	.	.
Warpage	.	.	.	Y	.	.	.	.	.	.	.	.	.	.	.
Effloresces	.	.	.	Y	.	.	.	.	.	.	.	.	.	.	.
Water Absorption	.	.	.	Y	.	.	.	.	.	.	.	.	.	.	.
Compressive Strength	.	.	.	Y	Y	.	.	.	.	.	.	.	.	.	.
Plumb	.	Y	.	.	.	Y	.	.	.	.	.	.	.	.	.
Cutting tolerances	.	.	Y	.	.	.	.	.	.	.	.	.	.	.	.
Placement	.	.	Y	.	.	.	.	.	.	.	.	.	.	.	.
Dimensions	.	Y	Y	Y	.	.	.	.	.	.	.	.	Y	.	Y
Physical & Chemical Properties	.	.	Y	.	.	.	.	.	.	.	.	.	.	.	.
Cleanliness	.	Y	.	.	.	.	.	Y	.	.	.	.	.	.	.
Visual Exam.	Y	Y	Y	Y	.	Y	.	.	.	.	.	.	Y	.	Y
Joint Adequacy	Y	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durability, strength an soundness	Y	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Test Requirement Checks	Item/Components														
	3. Form Work	a) Staging	b) Shuttering	4. Reinforcement	5. Bricks	6. Mortar	7. Masonary	8. Water Supply & sanitary items	9. Water retaining structures (Tank/reservoir etc.)	10. Roof water proofing	11. RCC structures	12. Doors Windows	13. Pre-cast concrete members	14. All bought out items Approval by BHEL	



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CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test	<p>1. Quantum of check for R. T. on butt welds under tension zone shall be 100% and for remaining butt welds unless specified shall be 10%. Acceptances norms for NDTs shall be as per AWS D1.1</p> <p>2. RT on all butt welds for bunker supporting girders (Longitudinal/Transverse) shall be 100 %.</p> <p>3. RT on all butt welds for deaerator supporting girders shall be 100 %.</p> <p>4. All site fillet welds of bunker supporting structure shall be 100 % NDT.</p> <p>5. All above quality control and super vision shall be carried out by an independent inspection body.</p> <p>* 100% on 'T' joints and 10% on longitudinal and circumferential butt welds.</p>	
Hydraulic test		Y
All tests as per Indian/International Codes/Standards	Y	Y
Dimensional	Y	Y
Mechanical Test of Butt Weld Coupons	Y	-
Macrotech Exam. of Fillet Welds Coupons	Y	-
Fit up/Assy	Y	Y
Visual Exam.	Y	Y
Radiographic Test (RT) on Welds	Y	Y*
Liquid Penetration Test (LPT) on Welds	Y	Y
WPS/PQR/WQR	Y	Y
Ultrasonic Test (UT) on Material Above 40 mm Thickness	Y	-
Material T.Cs	Y	Y
Test Requirements	15. Structural Steel Like Columns, Girders, Beams & Truss Etc.	16. C.W. Pipes/Ducts
Item/Components		



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CIVIL & STRUCTURAL WORKS

CIVIL & STRUCTURAL WORKS								
Warpage	16	Y	Y
Comp. Strength, bond strength working, time, chemical resistant	15	Y	Y
Compressive strength, Water absorption resistant to Acid, resistant to flexural strength, INEAD	14	.	.	.	.	.	Y	.
Positioning and location of laps and plumb level	13	.	.	.	.	Y	.	.
Storage	12	.	.	.	.	Y	.	.
Tests as per BHEL tech spec. and IS: 8183	11	.	.	.	Y	.	.	.
Check type of permanent colour coating	10	Y	Y	Y	.	.	.	.
Galvanizing test as per IS code	9	Y	.	Y	.	.	.	.
Check for coating of silicon modified polyester paint thickness	8	.	Y	Y	.	.	.	.
Dimensional conformity	7	.	Y	Y	Y	.	Y	.
T.Cs for fasteners &'Z' spacers	6	Y	.	.	.	.	.	.
Appearance	5	Y	.	.	.	Y	.	.
Sides end laps	4	Y	.	.	.	Y	.	.
Fixing of decking sheets	3	Y	.	.	.	.	.	.
Dimensional, thickness, depth of valley etc.	2	Y	.	.	.	.	.	.
T.Cs for Physical & Chemical properties	1	Y	Y	.	.	.	.	.
Test Requirements		17. Roof Decking sheets (Supply and fixing) 18. Wall Cladding work a) Outer sheet b) Inner sheet c) Insulation d) Fixing of wall cladding 19. Acid Resistant Lining a) Acid resistant Bricks/Tiles b) Acid resistant Mortar						
Item/Components								



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RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

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TECHNICAL SPECIFICATION FOR REINFORCED CONCRETE CHIMNEY

1.0.0 SCOPE

This specification covers reinforced cement concrete works, including brick flue and insulation work, painting and protective treatment work, and other works associated with construction of RCC single flue chimney.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

Work to be provided by the Contractor, unless specified otherwise, shall include but shall not be limited to the following:

- a) Furnish all labour, supervision, services, insurance, material, power, fuel forms, templates, supports, scaffolding, tools, plants, construction equipment, approaches, transportation etc. required for the entire work.
- b) Design and prepare working drawings for formworks, scaffoldings, supports, staging hoisting arrangement for men and material etc. and submit them for approval.
- c) Prepare and submit for approval, as per approved schedule, detailed drawings for RCC work in shell, platforms at various levels, roof and ground floor and bending schedules for reinforcement bars, showing the positions and details of spacers, chairs, supports, hangers, openings etc.
- d) If in scope, prepare detailed fabrication and erection marking drawings for steel flues including flue expansion compensators, steel flue supports and restraint arrangements along with fittings and accessories and submit them for approval.
 - e) Prepare and submit for approval detailed shop drawings, with list of materials and material specifications for Load Bearing Insulation Blocks and Lateral Restraint Insulation Blocks.



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- f) Prepare and submit for approval detailed schemes for operations like material handling, placement of concrete erection of steel flues, fixing of insulations, installation, dismantling and maintenance of flue expansion compensator etc. and for items like approaches, services etc.
- g) Design and submit for approval mix proportions for concrete to be adopted on job.
- h) Furnish samples and submit for approval the results of tests for various properties of the following materials:
 - i) Ingredients of concrete, (ii) Concrete,
 - iii) Acid/Chemical Resistant Tiles, (iv) Castable refractories, (v) Insulation materials, (vi) Paints. (vii) S/S liner.
- i) Provide all incidental items not specified or shown on drawings in particulars but reasonably implied or necessary for successful completion of the work in accordance with drawings and specifications.
- j) Produce, if directed by the Engineer, a guarantee, in approved proforma, for satisfactory performance, for a specified period, of material manufactured by specialist firms.

2.2.0 Work by Others

No work under this specification will be provided for by agency other than the Contractor for this Contract unless specifically mentioned otherwise in the Contract.

2.3.0 Codes and Standards


All works under this Specification, unless specified otherwise, shall conform to the latest revisions/replacements of the following Indian Standard Codes, Criteria, Specifications, along with those mentioned therein. In case any particular aspect of work is not covered by Indian Standards, other standard specification, as may be specified by the Engineer, shall be followed. "IS Specification" shall mean Codes, Criteria etc. of ISI.

- IS:6 Moderate heat duty fireclay refractories, Group-A.
- IS:104 Ready mixed paint, brushing, zinc chrome, priming.
- IS:158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purposes.



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- IS:195 Specification for fire clay mortar for laying fireclay refractory bricks.
- IS:269 Ordinary, and low heat Portland cement.
- IS:383 Coarse and fine aggregates from natural sources for concrete.
- IS:432 Mild steel and medium tensile steel bars.
- IS:456 Code of practice for plain and reinforced concrete.
- IS:516 Methods of test for strength of concrete.
- IS:732 Code of practice for electrical wiring installations (System Voltage not exceeding 650 Volts).
- IS:800 Code of practice for general construction in steel.
- IS:813 Scheme of symbols for welding.
- IS:814 Covered electrodes for metal arc welding of structural steel.
- IS:816 Code of practice for use of metal arc welding for general construction in mild steel.
- IS:817 Code of practice for training and testing of metal arc welders.
- IS:818 Code of practice for safety and health requirements in electric and gas welding and cutting operations.
- IS:822 Code of procedure for inspection of welds.
- IS:875 Draft Standard for Code of practice for structural safety of buildings loading standards.
- IS:1080 Code of practice for design and construction of simple spread foundations.
- IS:1139 Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcements.
- IS:1161 Steel tubes for structural purposes.
- IS:1199 Methods of sampling and analysis of concrete.
- IS:1200 Methods of measurement of building works.

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	IS:1230	Cast Iron Rainwater pipes and fittings.	
	IS:1239 (Part-I)	Mild steel tubes.	
	IS:1367	Technical supply conditions for threaded fasteners.	
	IS:1526	Sizes and shapes for firebricks (230 mm. series).	
	IS:1554	Cables.	
	IS:1566	Hard-drawn steel wire fabric for concrete reinforcement.	
	IS:1608	Methods for tensile testing of steel products.	
	IS:1730	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.	
	IS:1731	Dimensions for steel flats for structural and general engineering purposes.	
	IS:1786	Cold-twisted steel bars for concrete reinforcement.	
	IS:1791	Batch type concrete mixers.	
	IS:1893	Criteria for Earthquake Resistant Design of Structures.	
	IS:1947	Flood light.	
	IS:1977	Structural steel (ordinary quality).	
	IS:2062	Weldable structural steel.	
	IS:2074	Ready mixed paint, red oxide - zinc chrome priming.	
	IS:2309	Code of practice for the protection of buildings and allied structures against lightning.	
	IS:2386 (Part-I)	Methods of test for aggregates for concrete. Particle size and shape.	
	IS:2386 (Part-II)	Estimation of deleterious materials and organic impurities.	
	IS:2386 (Part-III)	Specific gravity, density, voids, absorption and bulking.	
	IS:2386 (Part-IV)	Mechanical properties.	
	IS:2386	Soundness.	



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(Part-V)

IS:2386 (Part-VI) Measuring mortar making properties of fine aggregate.

IS:2386 (Part-VII) Alkali aggregate reactivity.

IS:2386 (Part-VIII) Petrographic examination.

IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement.

IS:2505 Concrete vibrators, immersion type.

IS:2506 Screed board concrete vibrators.

IS:2633 Methods of testing uniformity of coating on zinc coated articles.

IS:2722 Portable swing weighbatchers for concrete (single and double bucket type).

IS:2750 Steel scaffoldings.

IS:2751 Code of practice for welding of mild steel bars used for reinforced concrete construction.

IS:2950 Code of practice for design and construction of raft foundations.

IS:3025 Methods of sampling and test (Physical and Chemical) for water used in industry.

IS:3043 Code of Earthing.

IS:3144 Methods of Test for Mineral Wool Thermal Insulation Material.

IS:3346 Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot- plate method).

IS:3495 (Part-I to IV) Method of test for clay building bricks.

IS:3550 Methods of test for routine control for water used in industry.

IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.



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- IS:3677 Unbonded rock and slag wool for thermal insulation.
- IS:4014 Code of practice for steel tubular scaffolding.
(Part-I&II)
- IS:4031 Method of physical tests for hydraulic cement.
- IS:4457 Ceramic Unglazed Vitreous acidresistant tiles.
- IS:4634 Method for testing performance of batch-type concrete mixers.
- IS:4687 Gland packing asbestos.
- IS:4832 Chemical Resistant mortars.
- IS:4860 Acid-resistant bricks.
- IS:4990 Plywood for concrete shuttering work.
- IS:4998 Criteria for design of reinforced concrete chimneys.
(Part-I)
- IS:5410 Cement paint, colour as required.
- IS:5445 Long fluted machine reamers with Morse taper shanks.
- IS:5495 Sizes and shapes for firebrick (300 mm. and higher series).
- IS:6911 Stainless Steel plate, sheet and strip.
- IS:8112 High strength ordinary portland cement.
- IS:8183 Bonded Mineral Wool.
- IS:9595 Recommendation for Metal Arc Welding of Carbon and Carbon Manganese steels.
- CP326 - British Standard - Protection of structures against lightning.
- NEPA NO. 78 Code of protection against lightning.
- The Indian Electricity Rules.
- The requirements of Department of Civil Aviation, Govt. of India.

2.4.0

Conformity with Drawings and Specifications



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RCC STACK

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The Contractor shall carry out all the work in strict accordance with the drawings stamped "Released for Construction" and specification issued to him and as per Contractor's detailed drawings approved by the Consulting Engineer. Prior to concreting, the Contractor shall prepare a check list on a set format of all items of work involved, and inform the Engineer well in advance so that the Engineer shall have the opportunity of satisfying himself if the works mentioned in the format are done according to drawings and specification, and he can allow the Contractor in writing to start pouring of concrete. The entire operation of concreting shall be carried on as per specification, to the complete satisfaction of the Engineer. No deviation from the drawings will be allowed unless otherwise directed by the Engineer in writing.

For Load Bearing Thermal Insulation block assembly and lateral restraint insulation block assembly, Contractor shall design sizes of all components of the blocks and details of their connections, supply and fabricate the same in accordance with the approved shop drawings prepared by him.

For steelwork and metal work, the Contractor shall design all connections, inserts for scaffolding, supply and fabricate all steelwork and metal work and furnish all connection materials in accordance with approved shop drawings prepared by him and/or as instructed by the Engineer, keeping in view the maximum utilization of the available sizes and shapes for metal components.

2.5.0 **Materials to be used**

2.5.1 **General Requirement**

All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer.

2.5.2 **Cement**



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Ordinary Portland cement of grade 43, as per the requirements laid down in IS:8112, shall be used, until otherwise stated elsewhere in the specification.

2.5.3 Coarse Aggregate

Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS:383 or IS:515 and shall be washed clean, if necessary. The maximum size of coarse aggregate for stack superstructure shall be 25 mm down graded, unless otherwise stated (vide serial 5(b) of clause 3.03.06). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation.

2.5.4 Fine Aggregate


Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned in the relevant IS Specifications.

2.5.5 Water

The water for both mixing and curing of concrete shall be clean, free from oil, acid, alkali, organic or other deleterious substances. Contractor shall test the water as and when required by the Engineer.

2.5.6 Reinforcement

Mild steel or Medium or High Tensile steel deformed bars specified for reinforcement shall conform to the latest relevant IS Specifications and shall be of tested quality under ISI

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Certification Scheme. The reinforcement shall be free from any oil, foreign material or mill or rust scales.

2.5.7 Steel Flue

- a) All mild steel material to be used in construction of steel flue shall comply with IS:2062, IS:1239, IS:1367, IS:1608, IS:800 and with other relevant IS Specifications. The ultimate tensile strength of this steel shall not be less than 410 N/Sq.mm.
- b) Stainless steel liners shall be fabricated using materials conforming to the requirements of relevant IS Specifications and/or AISI 316L or BS:1449 Part-2. Grade of Stainless steel shall be equivalent to BS:1449 (Part-2) 316 S.12.
- c) Materials to be used for fabrication of Flue expansion compensator shall be suitable for the flue gas temperature and shall be acid resisting.

The Expansion compensator shall comprise several layers of materials given below in order from the gas side.

- i) Two layer of insulation, each consisting of heavy weight texturized glass cloth impregnated with graphite suspension, having an approximate weight of 1.00 Kg/Sq.m
- ii) A continuous filament glass cloth coated both sides with a fluoro-elastomer having an approximate weight of 1.5 Kg/Sq.m.
- iii) Two layers of PTFE (Poly Tetra Fluoro-Ethylene) film of minimum thickness 0.15 mm each.
- iv) A layer of glass felt of minimum thickness 10 mm and an approximate weight of 1.5 Kg/Sq.M.

2.5.8 Paints

Paints to be used for shop coat of fabricated steel shall conform to the IS:2074. Paint for treatment of outside face of Chimney with Cement water proof paint shall conform to IS:5410.

2.5.9 Acid Resistant Tiles and Castable Refractories



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Acid resistant tiles to be provided over roof of stack should conform to IS:4457. Matching mortars to be used for tiles. Castable refractories shall be of hydraulic setting, rapid hardening type. It shall have refractory properties similar to Fire bricks conforming to IS:6, Group-A and working temperature shall be upto 1350 Deg.C.

2.5.10 Insulations

a) On Exterior Surface of Flues

The normal flue gas temperature inside the flue shall be 145 Deg.C with momentary rise upto 400 Deg.C (Maximum) occasionally. The insulation material shall be able to withstand this temperature without any deterioration in thermal properties or breakdown. The thermal conductivity of the insulating material shall not exceed 0.06 W/M Deg.C at a mean temperature of 150 Deg.C. The insulation shall also not be affected by any acid condensation from flue gas and shall be free from any impurities which may cause corrosion to the flue material.


For steel flues 65 mm thick semi rigid resin bonded fibrous mineral wool of density not less than 96 Kg/Cu.m as per IS:8183 or resin bonded fibrous crown glass wool (high temperature) of same thickness and density not less than 36 Kg/Cu.m capable of sustaining temperature to the tune of 540 Deg.C without any loss of material thermal property, may be used. The mineral wool for exposed top portion of flue shall be semi-rigid with minimum density of 200 Kg/Cu.M or the glass wool for exposed top portion of flue shall have minimum density of 75 Kg/Cu.M.

Slag wool insulation shall not be accepted.

The insulation free from shots should be supplied in the form of mat to be fixed with staggered joints on outer surface of the flue with suitably spaced stud by galvanised wire mesh. Insulation on the top portion of flue shall be covered by stainless steel cladding.

b) At Load Bearing and Side Restraints of Flues

Load bearing insulation assembly to have (i) a properly mechined mild steel plate with recess at its top for seating PTFE (Poly Tetra Fluoro Ethylene) sheets conforming to BS:5400 (ii) saddle plate (MS) in the middle having stainless steel plate fixed at its bottom surface and lead/elastomeric sheet at top, and (iii) top plate formed of two numbers insulation blocks each made of minimum 50mm thick rigid, non-combustible asbestos fibre reinforced lime-silica board (SINDANYO BLOCKS NATURAL GRADE CS-51) bonded to mild steel plates at top and bottom. For side restraints assembly of insulation blocks of SINDANYO Natural Grade CS-51 and stainless

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steel plate shall be used. All stainless steel in these assemblies shall conform to AISI-316L and Mild steel to IS-2062. SINDANYO BLOCKS shall be suitable for operation at 320 Deg.C and shall primarily satisfy the following physical properties :

- i) Minimum compressive stress prior to onset of compression yield of not less than 12 N/Sq.mm.
- ii) Minimum shear strength of 30 N/Sq.mm when tested in accordance with BS:3497-1979.
- iii) Thermal conductivity shall not exceed 0.67 W/m Deg.C at a mean temperature of 200 Deg.C and its coeff. of linear expansion not to exceed 1.2×10^{-5} per Deg.C.
- iv) Adhesive used for bonding purposes shall be of material with equivalent high temperature properties as approved by the Engineer. It may be of "Fortafix Fiborclad Adhesive" as manufactured by Fortafix Ltd., England.

2.6.0 Storage of Materials

2.6.1 General

All materials shall be so stored as to prevent deterioration and intrusion of foreign matter and to ensure the preservation of their quality and characteristics for the work. Any material, which is deteriorated or is damaged or is otherwise considered defective by the Engineer, shall not be used for construction and shall be removed from site immediately, failing which the Engineer shall be at liberty to get the materials removed. The Contractor shall maintain an upto date accounts of receipt, issue and balance of all materials issued by the Owner.

2.6.2 Cement

Contractor shall store cement in water-tight and properly designed stores so that the Cement can be kept dry and the stock can be handled in rotation. The doors of stores shall



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be at least 30 cm. above G.L. Deteriorated cement shall be removed immediately from the site. Not more than ten bags of cement shall be stacked one above the other.

2.6.3 Aggregate

Different materials shall be transported, handled and stored separately in such a manner as to prevent damage, deterioration or contamination. Stock piles of fine and coarse aggregates shall be allowed to drain, so that aggregates do not contain too much water.

2.6.4 Reinforcement

Reinforcement shall be stored preferably under cover and stacked off ground in size and grade-wise separate stacks for easy identification.

2.6.5 Steel, Metal and Fittings

All steel, metal and fittings to be used for fabrication and erection shall be stored sectionwise and lengthwise in separate stacks, off ground, so that they can be handled, inspected, measured and accounted for easily at any time. If required by the Engineer, the materials may have to be stored in a covered shed.

2.6.6 Paints

Paints shall be stored under cover, in air-tight containers. Paints supplied in sealed containers shall be used as soon as possible once the container is opened. Left over paints shall be kept in air-tight containers.

2.6.7 Steel Flue

Fabricated pieces of steel (flue) liner shall be stored systematically for ease of handling.

2.6.8 Insulation Material

All insulation materials like bearing insulation blocks, restraint insulation blocks, glass or mineral wool, asbestos ropes etc. shall be stored in packing boxes, under covered shed, avoiding their coming in contact with objectionable matter.

2.7.0 Quality Control

Contractor shall establish and maintain quality control for different items or work and materials as may be directed by the Engineer to assure compliance with contract requirement and submit to the Engineer records of the same.



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The Contractor shall submit all records and test results in original to the Engineer for his approval, if so desired by him.

The quality control operation shall include but shall not be limited to the following items of work :

- a) Cement : Test to satisfy relevant IS Specifications if supplied by the Contractor.
- b) Aggregate : Physical, Chemical and Mineralogical qualities, grading, moisture contents and impurities.
- c) Water : Impurities Test.
- d) Reinforcement: Material tests or certificates to satisfy relevant IS Specification if supplied by the Contractor.
- e) Structural : Material tests or certificate to satisfy Steelrelevant IS Specification if supplied by the Contractor.
- f) Steel flue : Material tests or certificate to satisfy relevant IS Specification if supplied by the Contractor.
- g) Stainless : Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.
- h) Acid Resistant : Compressive and tensile strength, acid tiles& mortar resistance and water absorption test.
- i) Mortar : Compressive and tensile strength, adhesion and acid resistance test.
- j) Insulation : Thermal conductivity, density, heat and acid resistance tests. Bearing capacity will be tested for bearing/restraint insulation blocks.

3.0.0 EXECUTION

3.1.0 Concrete

3.1.1 Trial Mix, Grades of Concrete



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At least three weeks before commencing any concreting in the work the Contractor shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the work. A clean dry mixer shall be used for mixing and the first batch shall be discarded.

For guidance in designing the mix, standard tables for maximum allowable water-cement ratio, minimum cement content, maximum proportion of aggregates and limits of consistency may be used by the Contractor. The Contractor's design mix shall fall within limits of the following tables :

- i) Strength requirements of concrete : Table-2 of IS:456-2000.
- ii) Concrete Mix Proportion : Table-3 of IS:456-2000.
- iii) Minimum cement content/Cu.m. of finished concrete shall be as per Table 5 of IS 456-2000.
However, it should be noted that minimum cement content for concrete of chimney shell of grade M30,M35,M40 shall be 400kg, 430 kg and 450 kg respectively.
- iv) Limit of consistency : Refer Table in Item 3.1.4 of this specification.
- v) Cement/Total Aggregate Ratio : As per the following table.



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MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO (FOR GUIDANCE)

3.1 CEMENT/TOTAL AGGREGATES RATIOS

Workability	Water/ Cement Ratio	Ratio by Weight of Cement to Gravel Aggregate		Ratio by Weight of Cement to Crushed Stone Aggregate	
		20 mm. Size	38 mm. size	20 mm. size	38 mm. size
Very Low slump 0-25 mm.	0.4	01:04.8	01:05.3	01:04.5	1:05
	0.5	01:07.2	01:07.7	01:06.5	01:07.4
	0.6	01:09.4	1:10	01:07.8	01:09.6
	0.7	1:10	1:12	01:08.7	01:10.6
Low slump 25-50 mm	0.4	01:03.9	01:04.5	01:03.5	1:04
	0.5	01:05.5	01:06.7	1:05	01:05.5
	0.6	01:06.8	01:07.4	01:06.3	1:07
	0.7	1:08	01:08.5	01:07.4	1:08
Medium slump 50-100mm.	0.4	01:03.5	01:03.8	01:03.1	01:03.6
	0.5	01:04.8	01:05.7	01:04.2	1:05
	0.6	1:06	01:07.3	01:05.2	01:06.2
High slump 100 - 175 mm.	0.4	01:03.2	01:03.5	01:02.9	01:03.3
	0.5	01:04.4	01:05.2	01:03.9	01:04.6
	0.6	01:05.4	01:06.7	01:04.7	01:05.7
	0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTE-1 : Notwithstanding anything mentioned above, the cement / Total aggregate ratio is not to be increased beyond 1:9 without specific permission of the Engineer.

It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water-cement ratios which may be required to be used in mass concrete work only.



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NOTE-2 : The above figures are for guidance only, the actual cement/ aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes. For each grade of concrete, a set of eighteen cubes shall be made. Of these not more than six may be made on any day and further, of the six cubes made in one day not more than two cubes may be made from any single batch. Nine of these cubes each representing a different batch of concrete shall be tested at the age of seven days and remaining at twenty eight days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with the relevant IS Specifications. The test shall be carried out in laboratory approved by the Engineer. If the average strength of the concrete cubes falls below the requirement, the method described above shall be repeated till acceptable results are obtained. The method may have to be repeated whenever there is a significant change in the quality of any of the ingredients for concrete, at the discretion of the Engineer.

3.1.2 Batching of Concrete

For controlled concrete, only weigh batching shall be allowed. All concrete ingredients, except water, shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer.

3.1.3 Mixing of Concrete

Materials for concrete shall be emptied in rotation into the mixer. When all the ingredients are in the drum, the drum will rotate for one minute for dry mixing. After that water shall be added in measured quantities in the manner specified. The mixer shall then rotate for at



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least two minutes, or at least forty revolutions or until there is apparent uniform distribution of the materials and till the mass is uniform in colour. The entire content of the drum shall be discharged before the ingredients for the succeeding batch are fed into the drum. The mixer shall be thoroughly cleaned to the satisfaction of the Engineer, before a different quality of concrete is put through the mixer and also at the end of day's work.

3.1.4 **Workability of Concrete**

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments, and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. 120 mm to 150 mm, where concrete is pumped, otherwise, 100mm-120mm slump in chimney shell works shall be adopted subject to Engineer's approval unless stated otherwise (vide serial 1(d) of clause no. 3.3.6). The usual limits of consistency for various types of structure are given below:



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LIMITS OF CONSISTENCY

Degree of Workability	Slump in mm. with Standard Concrete		Use for which Concrete is suitable	
	Min.	Max.		
Very Low	0	15	Large mass concrete work with heavy compaction equipment.	
Medium	35	65	Deep and wide RCC structures with congestion of reinforcement and inserts.	
1.1.1	High	65	100	Very narrow and deep
	RCC structures			
	1.1.2			with congestion due to reinforcement
	1.1.3			and inserts.

NOTE: The above table is for guidance only. Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately, to keep the ratio of water to cement same, as adopted in trial mix design, for each grade of concrete.

The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively, where facilities exist or if required by the Engineer, the compacting factor test, in accordance with IS:1199, shall be carried out.

3.1.5 Placing and Compaction of Concrete

Concreting shall proceed in a manner directed by the Engineer, concrete shall be placed in forms as soon as possible but in no case later than twenty minutes, after mixing.

The height of any single lift of concrete, for different structural members, shall be decided by the Engineer. The concrete shall be placed in the forms gently and not dropped from a height which may cause segregation of aggregates. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow



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each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken an initial set.

The concrete, after placing, shall be consolidated only by power driven vibrators. The vibrators shall be of a make and size, approved by the Engineer. In using the vibrator, the standard practice and the Engineer's directions, shall be followed.

Vibration shall begin as soon as one batch of concrete has been placed and shall continue till the entire section being poured has been thoroughly consolidated.

To secure even and dense surfaces, free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic, without damaging or endangering the stability of the formwork.

A sufficient number of spare vibrators including petrol vibrators shall be kept readily accessible to the place of deposition of the concrete to assure adequate vibration in case of breakdown of those in use.

3.1.6 Curing of Concrete

Curing of exposed surface of concrete shall commence immediately after the concrete has set. Exposed sides shall be covered with canvas etc. immediately after stripping of forms, and curing shall be continued for a period of not less than 14 days, reckoned from the date and hour of completion of concreting. All surfaces of the pour shall be kept wet with water at all times after concreting and till the curing period is over. The Contractor shall plan and employ proper equipment and sufficient labour considered adequate by the Engineer under able supervisor for curing.



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3.1.7 Construction Joints

In concreting the chimney shell one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts the horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Contractor shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance.

3.1.8 Ordinary Concrete

Ordinary concrete like lean concrete shall be of nominal mix as per relevant clauses of IS:456.

3.2.0 Reinforcement

3.2.1 Bending of Reinforcement

All bars shall be carefully and accurately bent by the Contractor in accordance with approved Drawings and bar bending schedules. Special care shall be taken to ensure correct lengths of laps. The bars shall not be bent or straightened in any manner that will injure the bars or impair the bond between reinforcement & concrete. Bends and hooks are to be provided as laid down in the IS:2502.

3.2.2 Placing



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All reinforcement shall be placed and maintained in the position shown in the drawings.

Contractor shall provide approved type of cover blocks to suit the requirement of the Drawings. Where reinforcement is to be provided on two faces of the shell, the Contractor shall provide adequate number of separators, with the approval of the Engineer. Any additional support to the reinforcing cage, if required at the time of concreting, shall also be provided, to the satisfaction of the Engineer. Lapping of reinforcement as specified in the drawings or as directed by the Engineer, shall be provided. Laps shall be staggered and too many laps shall be avoided. Welded laps shall be provided only when directed or approved by the Engineer.

3.2.3 Fixing of Reinforcement

18 SWG annealed steel wire shall be used as binding wire. Bar crossing one another and contact laps shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.



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3.10 Forms

Construction by Slip-form Method

Slip-form construction shall be for construction of the wind shield. Type of Slip-form proposed should be indicated in the offer with sketches, drawings and construction statement as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour should also be indicated. The chosen scheme shall be of a past proven design. A certified performance record of the scheme should be submitted with the offer to guarantee workability of the scheme both from execution time and safety point of view.

The Tenderer should furnish a brief but comprehensive statement indicating the planning & programme and method of work to be followed, for the approval of Owner at the time of submitting Tender. This statement shall include the following items:

- i) Type and description of Slip-form equipment and its accessories.
- ii) Design of scaffolding and staging.
- iii) Description of materials including admixtures to be used for construction.
- iv) Manpower planning, construction spaces required, standby arrangement.
- vi) Rate of Slip-forming.
- vii) Proposed workability requirement of concrete and type of cement & admixture to be used.
- viii) Quality assurance programme.
- ix) Method of Transportation of material
- x) Method of curing and rectification of defects.



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- xi) Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint.
- xii) Contingency solution for unplanned interruptions.
- xiii) Time of completion.

While selecting the Contractor, due consideration will be given to the merit of the above mentioned statement proposed by the Tenderer.

Notwithstanding what have been specified in earlier clauses, following guide lines are being presented which should be kept in view by intending Tenderers, while quoting for Slip-form method of construction:

1. Care to be taken to prevent dragging of concrete along with upward movement of the shuttering. For this purpose following steps are advisable:
 - a) Shutter plates have to be smooth and should be thoroughly clean. Before fixing them in position all the surfaces which will be coming in contact with concrete to have a coat of epoxy paint.
 - b) In areas where concrete thickness is 750 mm or more, rate of pouring should be such that minimum slipping of shuttering is maintained to avoid initial set of concrete before slip form movement.
 - c) Mix design should be so done that it will be self- lubricant at the contact face of shutter and concrete and thus reduce friction. Suitable cement of approved manufacturer (conforming to relevant I.S. Specification) may be used for the purpose. An optimum ratio of coarse/fine aggregate should be established to suit the purpose depending on availability of aggregates.
 - d) Mix design also should be so done that it has a slump of around 100mm-120mm, at the point where concrete is placed under an ambient temperature of around 40 Deg.C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 minutes. Suitable retarding agent and plasticizer of approved manufacture may be added in mix to achieve this purpose.



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These admixtures to be properly identified by preliminary tests both for performance and for compatibility with particular type of cement proposed to be used.

Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40 Deg.C.

2. Care must be taken to prevent twist, which predominantly occur in the initial stages because of low slipping rate, in the horizontal plane of Slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person should exclusively be assigned this work together with rectifying any defect.
3. Every endeavour has to be made so as not to occur any tilt in the shutter assembly. To achieve this following steps need be taken:
 - a) Performance of jacks has to be closely observed and any defective one needs immediate replacement. Difference in levels of opposite jacks at any instant of time should not exceed 5 mm.
 - b) Loading on Slip-form truss/yokes has to be fairly equal.
 - c) Sleeve through which jacking rod passes has to be of sufficient length so that later gets an uniform clearance and does not get any chance to tilt. Sleeve should have a minimum wall thickness of 3.25 mm and should be such that jacking rod gets a maximum clearance of 1 mm to 1.5 mm around.
4. For taper walled chimneys overlapping of shutters which are kept to effect the tapering, needs careful attention otherwise these may be filled with concrete slurry.
5. In designing the mix following aspects should be borne in mind:
 - a) Cement used should have an initial setting time of not less than 50 minutes and preferably should have a specific surface around 3600 Sq.Cm.per gram.
 - b) Coarse and fine aggregates should be well graded and rounded aggregates offer better performance in Slip-form technique. These help to keep down water/cement ratio and also offers better lubrication between concrete and shutter surface. 40 mm down size of coarse aggregates should preferably be used unless reinforcement detailing calls for lesser size aggregates.



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- c) From the point of view of creep, shrinkage as well as initial setting property of concrete, cement content should not preferably be more than 450 Kg. per Cu.M of concrete.
- d) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slipform proceeds should be between 0.1 to 0.2 Newton/ Sq.mm.
- e) It is advisable to use cement from a single source during the entire operation of slipform technique since once the system starts, there might not be any time left for conducting trial mixes if the source of procurement of cement changes.

6. Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter - only in exceptional cases. At least two nos. standby vibrator units should always be maintained on top of working deck at all time during the entire period of slipform operation.

7. It is preferable to have membrane curing compounds sprayed on fresh surfaces emerging out of shutter panels for ensuring proper curing at great heights.


In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is always advisable to have a stand-by pump for effective utilisation of the system.

8. Rate of slipping should be around 100 mm – 150mm per hour, subjected to a maximum limit of 3.0 m per 24hrs.

9. Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc.

It is desirable that jacking system, based on which the entire slip form system works, should consist of jacks 3 Tonne/ 6 Tonne capacity and a hydraulic pump with necessary pipe connections.

Spacing of yoke legs should preferably be kept within 2 metres to prevent overloading on jacks and consequent failure resulting in twist of the formwork.

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Jacking rods should be of 25 mm diameter for 3 Tonne Jacks and 32 mm diameter for 6 Tonne Jacks.

10. At least 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump along with a set of loose pipes in perfect working condition on top of working deck.
11. In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slip form yoke.
12. For effective utility of this technique following areas need careful attentions at the very conceptual stage:
 - a) Detailed quality assurance programme.
 - b) Advance Planning and preparations.
 - c) Arrangement for on site supervision and adequate access facilities.
13. Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, description and frequency of various checks and tests for Slipform technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared beforehand by executing agency and to be approved by Engineer before starting the actual work.
14. Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement.

Vertical reinforcements should be kept vertical by providing suitable holders within the slipform system.
15. It is desirable to have a break of at least one day for every two weeks of continuous operation. Such break should be utilised for various maintenance activities, removal of jack rods etc.
16. Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and



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reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete.

For movement of personnel supervising the work a separate hoist must be arranged for.

17. The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system alongwith slipform.

18. Winches for lifting men and material and mixers, if located within unsafe area around chimney, should be protected by adequate shelter from possible damage.

19. Proper tele-communication system has to be established between the personnel working on top of Chimney and control room below.

20. A small laboratory should be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube testing machine may also be installed at site for getting quick feed back results.

Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers.

21. In case of interruption in the course of slipping of formwork following measures should be taken:

a) Provision of a key and additional reinforcement at the junction of new and old concrete.

b) Slip form system should be brought up freely to have a minimum overlap of 100 mm or so over previously cast concrete.

c) Washing of old concrete surface with compressed air and water jet and thereafter pouring a layer of neat cement grout.

d) Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Engineer.

e) Neatly finishing the interface of old or new concrete as soon as it comes out of shutter panel.

22. It is preferable to suspend the construction work under high wind condition.

23. It is of utmost importance that for effective implementation of this system an Engineer fully conversant with Slip form technique with



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enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid level supervisory staff, skilled workers and operators, having experience of similar construction in past. It is to be noted that enough manpower (as agreed by owners engineer at site) of above mentioned quality, is always ensured at site for smooth and uninterrupted work of slip form.

24. Operation of slip form method of construction is a continuous one and it demands continuous/intermediate inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity.
25. While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities should be carried out under the guidance of a qualified and trained safety Engineer.
26. For smooth and unhindered supply of concrete, while the slip form is in operation, it is desired that batching plant for concrete of chimney shell be placed in close proximity of chimney shell. However, all the safety measures required for placing batching plant close to shell must be ensured.

Safety measures as listed below must be adhered to but should not be limited to only these:

- a) Safety helmets and belts to be provided to all supervising staff and workers.
- b) Safety nets to be provided below both inside and outside platforms as instructed by Engineer.
- c) Hand railing and toe guard to be provided around all openings and platforms.
- d) Regular maintenance of equipment, checking of hoists, scaffoldings etc.
- e) Passenger hoist must have multiple ropes with adequate factor of safety.
- f) Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the Specification and to be operative in case of sudden power failure Emergency standby generator must be kept ready during the entire period of slipform method of construction.



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g) Emergency vehicles, first aid facilities must be kept ready during the entire period of work.

26. Permissible construction tolerances should be limited to the following:

Variation in wall thickness : (-) 5 mm, (+) 25 mm

Variation from Design Diameter : (\pm) 25 mm or (\pm) 2.5 mm per 3 m dia. whichever is larger, but in no case more than (\pm) 5 mm.

Out of Plumb in General : 1 in 1000 of height subject to a maximum of 200 mm.

3.4.0 Steel Flues

3.4.1 General

Fabrication and erection of Steel Flues shall conform to "Technical Specification for Fabrication and Erection of Structural Steelworks" furnished in this Specification.

3.4.2 Fabrication

Plates out of which flues will be fabricated, should be bent to the required shape on an appropriate machine. No smithy process shall be adopted for the purpose. Plates are to be prevented from distorting by more than the tolerances specified during transportation, storage, handling, erection and jointing. All components should be correctly located and brought into correct alignment and level within specified erection tolerances, before adjacent pieces are jointed or secured.

3.4.3 Assembly

Each flue would be assembled from its Component "Cans" near to ground level within the wind-shield. Incomplete flue would be hung only from the flue support platform during assembly, and progressively hoisted to enable connection of further cans at its lower end. Upon completion of the initial sectional length, this length will be hoisted and supported in its final position at the flue support floor as indicated in the drawing. It is envisaged that each flue will be assembled and hoisted in three sectional lengths; site joints between sectional length being located just above a steel floor level.

Joints between individual cans should be flanged and bolted on outside and to have sealed welded joints on inside in accordance with clause 3.3.0 - "Welded Construction" under Technical Specifications" for Fabrication of



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structural steel work. The Contractor shall submit a drawing showing proposals for erection and indicating locations of all site joints which should be kept to minimum.

3.4.4 Flue Expansion Compensator

For installation of Expansion Compensators, the manufacturer's instruction should form the basis of the Contractor's method. This method, in a statement, should be submitted to the Engineer for approval. Once approved it has to be followed throughout the installation sequence. Expansion Compensators should be prevented from distortion during transportation, handling, erection and jointing, by more stringent tolerances than specified by the manufacturer.

3.4.5 Tolerances

Permissible tolerances in the fabrication and erection of steel flues are given below :

- a) Internal diameter shall not vary by more than : ± 12 mm
- b) Centre of any section shall not be eccentric from vertical centre line by more than : 10 mm in any 15 metre height
- c) Centre of any section at height 'h' is in mm. above GL shall : $(h/2500 + 10)$ mm, not be vertical centre where line by more than
- d) Local deviation from a true circular form should not exceed the shell thickness (Measurement should be made from a segmental circular template having radius of flue shown in drawing and a chord length equal to 0.15 of that radius).
- e) Peaking or stepping at welded horizontal seams shall not exceed 4 mm. (Measurement shall be made with a straight edged template long enough to contact the straight shell on either side of the peaked area).

3.4.6 Erection

Erection of Steel Flues and C.I. Chimney caps shall be done as per requirement of IS:800.

The Contractor shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be



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provided by the Contractor. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate.

3.5.0 Insulation and Protective Treatment

3.5.1 Acid and Heat Resistant Paint

Top 15 meters of the outside face of R.C.C. windshield horizontal surface at the top of windshield and inside face from the top of the windshield to the top of roof slab or as specified in the drawing shall receive a protective treatment of three coats of acid and heat resistant black paint. The quality and type of the paint shall have the prior approval of the Engineer. For this, a small area shall be painted and a sample of paint shall be shown to the Engineer.

The surface to be painted shall be prepared and primary coat, if required as per the paint manufacturer's specification and direction of the Engineer, shall be applied. The paint shall conform, unless otherwise stated, to the requirement of IS:158. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for his approval. The surface to be painted shall be completely dry before the paint is applied and the drying time between consecutive coats shall not be less than 5 hours. The overall combined thickness of paint shall be a minimum of 230 microns.

3.5.2 Cement Paint

The outside face of the Chimney shell, unless specified otherwise, shall be painted with Cement water proof paint. The quality shall be approved by the Engineer. Necessary samples shall be submitted to the Engineer for his approval. The surface of the shell shall be prepared as per paint manufacturer's specification. In addition, care shall be taken that the surface is free from stain, honey comb and any rough and uneven surface. The joints between two shuttering and two lifts of shuttering shall be so prepared that any unevenness, if by chance exists, shall be removed. If one coat of paint is not sufficient to give the required finish, the Contractor shall repaint the surface, until the Engineer is satisfied with the workmanship. The paint shall conform, unless otherwise stated, to IS:5410. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for approval.

3.5.3 Insulation and Packing

All insulation material should be of dimension and type, shown in the drawing. Load bearing insulations at supports and side restraints of Steel liners should be an assembly of M.S. Plates, Stainless Steel Plates, PTFE (Poly Tetra Fluoro Ethylene) sheets and or/asbestos fibre reinforced boards (SINDANYO BLOCKS). Insulation to be fixed on outer surface of steel flues should be made of glass or mineral wool.



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a) **Load Bearing Insulation Block**

Load bearing assembly should consist of three units and be fabricated according to approved drawings. It would be fabricated from mild steel units with a stainless steel sheet bearing plate and load bearing insulation blocks as indicated in drawing.

The first unit is bolted to the supporting beam. It consists of a M.S. base plate with bolt holes on which a machined M.S. plate is welded. This plate is provided with recess for PTFE sheet (conforming to BS : 5400) to seat, being lubricated with silicon grease.

The second unit also consists of a M.S. plate having adequate size & thickness as shown in drawing. While one surface of the plate is provided with a stainless steel bearing plate the other surface has a thin layer of lead/ elastomeric sheet. The side having stainless steel surface is placed on PTFE surface of First unit.

The third unit consists of two layers of load bearing insulation blocks each having a minimum thickness of 50 mm and factory bonded to top & bottom M.S. plates. These are separated by 100 mm. long load bearing insulation dowels as shown in the drawing. These plates are in turn welded to two additional M.S. plates. Of the two surfaces thus created one shall be welded to bracket assembly while the other should rest on the lead sheet of second unit. Bearing assembly, thus formed, should be levelled by using suitable M.S. shims.

Support arrangement typically consists of flue support shoe (a part of flue), flue support bracket connected to the shoe by precision bolted connection. The bracket in turn is welded to the bearing assembly, which in turn is bolted to available supporting beams.

Support brackets and bearing assembly are welded to locally thickened area of flue. These support the flue on support platform at suitable locations indicated on the drawing.

The arrangement described above should cater for easy and smooth thermal movements of linear element. Suitable restraint brackets and M.S. stop plates need be provided as shown in drawings to prevent excessive movement and thus keeping different units of bearing assembly in proper position.

b) **Insulation Block at Lateral Restraints**

At flue restraint platforms, necessary restraint arrangement with load bearing insulation blocks and stainless steel bearing plates fixed to the insulation blocks should be provided as indicated in drawings.



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Restraint and support brackets need be provided for the bottom supported portion of the flue which rests on the support platform provided at the base to cater for bearing and restraint requirements.

c) **Glass or Mineral Wool**

Insulation thickness of 65 mm as is specified in clause 2.05.10 shall be built up using two (2) layers composed of 40mm and 25 mm thick insulation blocks. Thicker layer shall be put as first layer around the flue on its exterior surface.

The insulation on the flue shall be fixed using chicken G.I. wire mesh, G.I. wire ties, insulation retaining studs, washers etc. All joints shall be staggered. The insulation shall be tightly secured to the exterior surface of the flue by impaling on the studs and fixing in place by means of 63mm round or square metal plated speed washers. 20 gauge galvanized wire netting shall be wrapped continuously over the entire exterior of insulation. The wire mesh shall be 25mm hexagonal pattern conforming to IS:1566. All joints in the mesh shall be tapped a minimum of 150 mm tied by 16 gauge soft annealed wire at 300 mm spacings. Lacing at joints shall not be used. The Contractor before application of insulation, shall take prior approval of actual fixing arrangement from the Engineer.

The insulation shall be able to sustain structural vibrations and shall not settle under such conditions during erection, construction & operation. The insulation shall be suitably tied to prevent dislocation under adverse conditions.

The cladding of stainless steel sheet over the insulation shall be well secured using pins, fasteners etc.

d) **Vermiculite Concrete**

Vermiculite concrete shall be made by mixing exfoliated vermiculite, portland cement and water. It shall be of Grade-B, having a density of 210 Kg./Cu.M. The vermiculite aggregate size shall be maximum 6 mm. The mix shall be 1 cement and 8 vermiculite by volume.

3.6.0

Acid-Proof/Chemical Resistant Protection to Roof Slab

Acid-Proof/Chemical Resistant tiles bedded on acid proof/chemical resistant mortar shall be provided for the protection of roof slab. The intervening space between the tiles shall also be filled up by chemical resistant/acid-proof epoxy mortar grouts. The mortar shall be used immediately after mixing.

Tiles shall be made of clay, feldspar or quartz and vitrified at a high temperature in ceramic kilns. These should be unglazed, free from



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deleterious materials and should conform to IS:4457. Iron oxide in the raw materials used, shall not exceed 2 percent. They should show a fine grained, dense and homogenous fracture when broken. They shall be sound, true to shape, flat and free from flaws and other manufacturing defects. Dimensions of the tiles shall be 198.5 x 198.5 x 35 mm. Depth of the groove on the underside shall not be more than 3 mm. Compressive and tensile strengths of the tiles shall not be less than 70 N/Sq.mm and 3.5 N/Sq.mm respectively.

3.7.0 Flue Acid Drains and Manholes

Flue acid drainage system, where provided, will comprise of collection sumps, dilution manholes, conveying pipes including connection to main drainage system.

Stainless steel pipes, bends, collection sumps, fixing straps, bolts etc. conforming to the relevant Indian Standards (or in absence of which British Standard BS:3605) shall be used in work. Pipes should be cut and joined as per manufacturer's instructions so as to leave the surface clean and square to the axis of pipe.

Manhole should be constructed as per drawing. However, for general guidance it may be noted that pit of required dimensions should be excavated, lean concrete (1:2:4 mix) of required thickness to be laid, Acid-proof/Chemical resistant brick masonry in 1:4 acid resistant cement mortar of necessary thickness be built and both sides plastered by 12mm thick acid proof plaster (1:3 mix) having waterproof admixtures.

Manholes should be covered by reinforced concrete slab on which a heavy duty (HD) manhole cover with frame having diameter 560mm and total weight 255 Kg (140 Kg for manhole and 115 Kg for cover) is to be fixed. For additional safety another inner cover or other approved methods may be adopted. The manhole cover shall be distinctively coded to indicate the type of drainage involved.

Inside manholes necessary channels and benchings finished smooth by neat cement in cement concrete (1:2:4) and foot rungs made from 20mm round bars at 300mm centres and staggered should be provided. Rungs should project 100mm from wall face and be embedded 200mm inside cement concrete block made in that location of brick work. These foot rests shall be painted with coal tar in the projected portions and cement slurry in the embedded part. Joint of any pipe with brick work shall be rendered perfectly leak proof.

Pipes and fittings in the connection pipe to the main drainage system shall be vitrified clayware conforming to relevant IS and laid to the line and level indicated in the drawings.

3.8.0 Roof Drainage

3.8.1 General



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Rainwater outlets and down comers to run along inner face of stack wall, shall be made of standard cast iron rainwater pipes conforming to IS:1230. The brackets used to hold the pipes alongside the walls shall be wrought iron clevis type, split ring type or of perforated strap iron as approved by the Engineer. Each vertical pipe shall hang freely on its bracket fixed just below the socket. Suitable spacer blocks are to be kept in between the pipe and wall surface for fixing the pipe. All bends and junctions shall be provided with water tight clean-outs.

3.8.2 Pipe Joints


All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water tight when under ground. Method of pipe cutting and jointing shall be as per instruction of the pipe and fittings manufacturer or as approved by the Engineer. However following guidelines may be followed in absence of any instruction available from the manufacturer.

Socket and Spigot pipes shall be joined by cast lead joints. Spigot of the following pipe should be centred in the socket of the preceding pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. After the gasket or hemp yarn has been caulked tightly, a jointing ring shall be placed round the barrel and tightened against the face of the socket to prevent air lock. Molten lead shall then be placed round the barrel and tightened against the face of the socket. Thereafter molten lead should be poured in to fill the remainder of the socket and caulked with suitable tools tight round the joint to make up for shrinkage of the molten metal on cooling and should be finished 3mm behind the socket face. If any joint is suspected to be damaged it has to be opened out & redone. Joints in cast iron pipes with special jointing arrangements like "Tyton" joints etc. shall follow the instructions of the manufacturer.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 General

The Contractor shall carry out all sampling and testing in accordance with the relevant IS Specifications and as supplemented herein, for the following items or any other item as may be required by the Engineer unless otherwise specified in this specification. The Contractor shall get the specimens tested in laboratory, approved by the Engineer and shall submit to him, the original test results in triplicate, within seven days after the completion of the test. Engineer may present himself while such tests are being carried out.

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4.2.0 Cement

Representative samples shall be taken as per the relevant IS Specification from each consignment of Cement received from the Purchaser/Manufacturer/Supplier for carrying out the tests for fineness (by hand sieving), setting time, compressive strength and soundness tests, and the Contractor shall carry out the above tests as per relevant Indian Standard. If the cement is supplied by the Contractor the test shall be carried out by him. The Contractor shall carry out any or all the tests on aggregates as may be required by the Engineer, in accordance with IS:2386 Parts-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant IS specifications.

4.3.0 Water

Sampling and testing of water being used for concrete works shall be carried out as per IS:3550, by the Contractor, at regular intervals and whenever directed by the Engineer. The final acceptance criterion in case of doubt shall be as per IS:3025.

4.4.0 Concrete


The Contractor shall take cubes for works test as per requirement laid down in IS:516 regularly from the day's pour. The number of test cubes to be taken shall be as per IS:456. The Engineer may also use his discretion in deciding the rate of cubes to be taken. The acceptance criteria is to meet the requirement of IS:456. If the cube test results indicate that some portions of the work is below the required strength, the Engineer may order demolition of that portion of work which is below strength and ask the Contractor to rebuild, provided a satisfactory method of load testing is not possible. Such testing or demolishing and rebuilding shall be carried out by the Contractor.

4.5.0 Steel Flue

All site and shop welded joints shall be inspected and tested in accordance with clause 4.00.00 of Technical specification for Fab. and Erection of structural steel work.

4.6.0 Insulations

The insulating materials shall be tested for its stipulated characteristics and properties in accordance with the latest editions of IS:3144 and IS:3346 and/or as directed by the Engineer.

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5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The following technical information are required with the tender:

- a) Source and arrangement of processing of aggregates proposed to be adopted.
- b) Type of plant and equipment proposed to be used.
- c) Names of firms with which association is sought for to execute the special items of work e.g. flue expansion compensator, load bearing insulation blocks etc. in the contract.
- d) Types of formwork proposed to be used. All details as per clause no. 3.03.06 to be submitted, if slip form method is proposed to be used.
- e) Shop proposed for fabrication of steel (flue) liners. Detailed write-up on procedure of erection of complete liner system including details of equipment proposed for the same.
- f) For insulating material tests to be offered for inspection & tests for which test certificates will be submitted. A drawing showing the details of fixing insulation on the flues at bearings, lateral restraints and exterior surface.
- g) Proposal for lifting of men and material in constructing the chimney.

5.2.0 After Award

The following information and data including samples where necessary, shall be submitted by the Contractor, progressively during the execution of the Contract.

5.2.1 Programme of Execution and requirement of Materials

Within 30 days of the award of the Contract, the Contractor will submit a Master Programme for completion of the work giving monthwise requirement of materials, particularly mentioning in details the materials which are to be supplied by the Owner and for the procurement of which the help of the Owner is required as per the terms & conditions of the Contract. In case the Contractor proposes to take on hire any



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machinery or tools and plants from the Owner, the detailed phased out programme of such hire is also to be submitted.

The master programme may have to be reviewed and updated by the Contractor quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day to day programme of every month is to be submitted by the Contractor before the commencement of the month.

5.2.2 Samples

Samples of all materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities, for approval. All samples shall be submitted well in advance of starting work at site. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying material of specified quality.

5.2.3 Design Mix

Design mix as per details of this specification giving proportions of ingredients, sources of aggregates and cement along with accompanying test results of trial mixes as per relevant IS Specifications shall be submitted to the Engineer, for his approval, before it can be used on the work. Further, the mix design for concrete of shell to be validated from a third party agency of national repute, as agreed upon by the owner.

5.2.4 Detail Drawings

Following items shall be provided by the Contractor which are to be approved by the Owner and Consultant.

- a) Detail drawings and designs of form work including scaffolding to be used. If slipform method of construction is adopted, then detail drawings showing all the arrangements for slipform technique including methods for reducing internal diameter and providing required slopes on outer diameter.
- b) Detail drawings and bar bending schedules for concrete components.
- c) Shop drawings for structural steel and metal work, including inserts etc. The Contractor shall submit his proposal for testing site and shop joints provided in steel members.



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- d) Detail drawings for templates and temporary supports for embedments.
- e) Category wise requirements of MS, tor and structural steel including GI flats of various sizes for procurement.
- f) Detailed drawings of steel flues indicating details of joints, supports and restraints including insulation blocks, and details of expansion compensator.
- g) Detailed drawing of hoisting arrangement for men and material satisfying statutory regulations laid down for safety purpose.

5.2.5 Reports

Following Test Reports shall be furnished by the Contractor:

- a) Mill Test Report for cement and reinforcing steel if the materials are supplied by the Contractor.
- b) Inspection Report of bought out items.
- c) Inspection Report of formwork and reinforcement, insulations etc.
- d) Reports of tests of various material and concrete.
- e) Radiographic tests on welded joints in steel flues.
- d) Any other data or report or test result required by the relevant IS Specifications and if required by the Engineer for satisfactory quality control of the workmanship.



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**BOROSILICATE GLASS BLOCK
LINING SYSTEM**

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BOROSILICATE GLASS BLOCK LINING SYSTEM

SPECIFICATION NO. PE-TS-999-620-C002



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**BOROSILICATE GLASS BLOCK
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1 PROJECT DESCRIPTION

1.1. Description

This specification covers borosilicate glass block lining system in thermal power plant chimney.

1.2. Flue gas parameters

The chimney shall be working with the flue gas parameters as per Annexure-I.

1.3. General configuration

The Chimney general arrangement configuration shall be as provided elsewhere in the specification. However, during detailed engineering, modification may be done.

2 SCOPE OF WORK

2.1 Work to be provided by the contractor, unless specified otherwise, shall include but shall not limited to following:

2.1.1 Design, preparation of working drawings, material supply, erection, application, Handling, transportation, storage, preservation, pack and furnish with adequate moisture proof packing and test of borosilicate glass block lining system on flue liner substrate including:

- a) Suitable primer, two component suitable adhesive membrane and closed cell borosilicate glass blocks.
- b) Required Surface finish of flue liner substrate as recommended by borosilicate glass block lining system manufacturer/supplier.
- c) Installing borosilicate glass block lining system on flue liner substrate using two component suitable adhesive membrane under controlled temperature and humidity conditions, including skilled labor, material, tools & tackles, equipment required to create controlled temperature & humidity conditions during installation, hot blow cleaning (after priming, if required) of flue liner substrate before application, mixing of two component suitable adhesive membrane by automated mixing machines etc. all complete.
- d) Complete onsite QA and supervision, by borosilicate glass block lining manufacturer/supplier, during surface finish of flue liner substrate, application of primer, application of two components suitable adhesive membrane, installation of borosilicate glass blocks on flue liner substrate

2.1.2 All necessary parts, and works necessary for transport, storage and application purposes.

2.1.3 Submission of the drawings and getting the same approved from BHEL and the project owner.



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- 2.1.4 The contractor shall furnish all design, labor, materials, tools and equipment necessary for the installation of borosilicate lining system, as indicated and specified herein.
- 2.1.5 The Work shall include everything requisite and necessary to finish the job properly, to the satisfaction of engineer in charge, notwithstanding that every item of labor or materials or accessories required to make the installation complete may not be specifically mentioned.
- 2.1.6 The Equipment / material for the Unit shall be supplied complete with provisions for appurtenances and accessories, to form a complete system which will achieve and assure safe and reliable operation with best overall performance.
- 2.1.7 Contractor shall provide, in the required format and form and in a timely manner, all drawings and documentation required by this Specification and/or required by applicable Standards and codes. A consistent nomenclature shall be used project-wide in naming all component parts within the Scope of Work. This shall apply to all drawings, Bill of Materials, special instructions, etc. The cost of correcting inconsistent nomenclature shall be borne by the contractor.
- 2.1.8 Changes in design and drawings already approved by the owner are normally unaccepted. However, should such changes become necessary on an exceptional basis, the contractor shall obtain the owners approval prior to introducing any such change.

2.2 Contractor Services

Field personnel provided by the contractor shall be capable and qualified to perform the required duties to the satisfaction of BHEL and the owner.

3 SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS

Contractor shall provide all special equipment, tools and instruments, skilled manpower required for handling and storage, and for test and maintenance of borosilicate glass block lining system provided under this Contract.

4 STANDARDS AND CODES

4.1 The borosilicate glass block lining system to be provided under this Specification, including all appurtenances and accessories, shall be designed, inspected, tested, stamped and preserved to the extent indicated in said referenced standards and codes. Where this Specification does not include such reference, the system, or any of its components, shall be designed, inspected, tested and preserved, as applicable, to comply with currently recognized International and/or manufacturer's/suppliers specification, whichever is stringent and more restrictive.

4.2 In all cases contractor shall adhere to and comply with the requirements of Indian standards, which are found to be more restrictive than those specified herein.

5 QUALITY ASSURANCE AND QUALITY CONTROL

5.1 The contractor shall submit upon request a copy of Its Quality Assurance Manual including Quality Procedures.



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- 5.2 The contractor shall conduct an inspection and testing program which shall record and verify the essential properties of the constituent materials and the finished liner.
- 5.3 The contractor shall conduct test to verify the mechanical properties of borosilicate glass blocks and two components suitable adhesive membrane and the tests shall be documented during the course of design and shall be made available to owner.
- 5.4 Unless otherwise specified the contractor, standard tests shall be performed on all batches of materials furnished. The owner may or may not elect to witness tests, but the contractor shall notify the owner in advance of all scheduled tests.

6 SAFETY, NOISE AND ENVIRONMENT REQUIREMENTS

6.1 SAFETY

The material and equipment supplied under this specification shall meet the U.S. "OCCUPATION, SAFETY, AND HAZARD ADMINISTRATION" (OSHA) requirements or equivalent.

6.1.1 Jobsite Safety and Scrap Disposal

- Safety programs and procedures shall be within the scope of this specification. It should be noted that materials that are potentially flammable, must be handled in keeping with good industry practice and in compliance with the manufacturer/supplier recommendations.
- Proper disposal of scrap and waste materials shall be followed by the contractor as instructed by owner.

6.1.2 Safety and protection of material, work and property:

The contractor shall provide for the safety and protection of the work, materials and equipment to be incorporated therein, whether in storage on or off the site. Provide protection at all times against rain, wind, storms, condensation, or heat so as to maintain all work, equipment and materials free from damage. At the end of each day, all new work likely to be damaged shall be appropriately protected.

6.2 Environmental Data

- 6.2.1 The contractor, upon request shall provide a plan for the treatment of the discharge/waste to meet current regulations of the Indian government/ regulatory authorities.
- 6.2.2 The contractor, upon request shall provide additional information on noise and/or other environmental data. All information shall be prepared in a manner acceptable to Indian government/ regulatory authorities.

7 TECHNICAL REQUIREMENTS



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7.1 Design parameters

7.1.1 Liner considerations

The borosilicate glass blocks shall be of suitable thickness as per the scope. Proper provisioning should be made for borosilicate glass block lining system for protection around gas sampling ports, expansion joints, man holes, mini-shell and other appurtenances.

7.2 Performance Requirements

7.2.1 Borosilicate glass block lining system shall be designed in such a way that it will not require unscheduled outages for repair except for planned and scheduled routine maintenance and inspections.

7.2.2 Borosilicate glass block lining system and all of the required components shall be designed for a safe, useful life of thirty (30) years (minimum).

7.2.3 Ten (10) year full replacement guarantee, including supply, erection, enabling works, labor, material (borosilicate glass blocks, two components suitable adhesive membrane, suitable primer), surface preparation, arrangement for application etc. all complete, and fulltime onsite QA supervision during erection & commissioning.

During the guarantee period if the lining system fails to protect the subject surface from deterioration, the contractor shall replace the partially affected portion or complete borosilicate glass block lining system without any additional cost.

7.2.4 The borosilicate glass block lining system shall be offered by a manufacture/supplier with demonstrated capabilities in the area of onsite technical support and QA/QC supervision, who employs QA/QC supervisors with a demonstrated experience in technical support and QA/QC supervision of the subject lining system.

7.2.5 The borosilicate glass block supplied lining system shall be capable of withstanding fire risk for a minimum period of 2 hours as per ASTM E-119 or equivalent codes/standards. Proper certification from an independent institute of sufficient knowledge and experience shall be submitted by supplier subject to acceptance by the project owner, showing the capability of the borosilicate glass block lining to protect the steel chimney flues from structural damage by fire of said rating.

7.2.6 Contractor shall produce certificates from an independent institute of sufficient knowledge and experience, subject to acceptance by the



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project owner, showing that the workers can do the work on supplied lining system safely, without any adverse health effects and without requiring excessive protective measures.

7.3 Design Requirements

7.3.1 General

- Design of the borosilicate lining system must be performed by a professional engineer in the design of such system for thermal power plant chimneys.
- Requirements of this specification are to be regarded as minimum requirements. If the manufacturer/supplier design and/or experience dictate these minimum requirements should be exceeded, the design, supply and application shall be performed accordingly, without any extra cost implication.

7.4 Materials Requirements

The flue liner substrate shall be internally protected with borosilicate glass block lining system consisting closed cell borosilicate glass blocks, two components suitable adhesive membrane and suitable epoxy primer meeting all of the following requirements:

7.4.1 The borosilicate glass block lining system shall use closed cell borosilicate glass blocks with the following properties:

- a. Density of $0.19 \times 10^3 \text{ kg/m}^3$ (+/- 20%).
- b. Coefficient of linear thermal expansion not greater than $5.7 \times 10^{-6}/^\circ\text{C}$.
- c. Min. compressive strength of 1.00Mpa as per ASTM C165/C240.
- d. Minimum flexural strength of 0.62 Mpa as per ASTM C203/C240.
- e. The blocks shall be resistant to thermal cyclic loading under FGD bypass/ hot gas service conditions, and sudden temperature changes, including high temperature spikes.

7.4.2 The borosilicate glass block system shall use a flexible, chemically resistant adhesive, with all required surface preparation, primer, labor, equipment etc., all complete. The adhesive membrane shall be a 2-component having excellent elastomeric properties and be acid & heat resistant. The adhesive membrane shall be applied in between and behind the blocks in a minimum 3 mm thick layer ensuring a proper bond and adhesion. The adhesive membrane shall have the following properties.

- a. Minimum tensile strength at 23 °C of 1.0 N/mm² as per ASTM D412
- b. Resistant to corrosive flue gas environments.
- c. Remain elastomeric and flexible under hot gas conditions and sudden temperature changes.
- d. The adhesive shall be suitable for trowel application.



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7.4.3 The steel substrate shall be grit blasted to a cleanliness of SA 2 1/2 and approved by the manufacturer/supplier of the borosilicate glass block lining system. The substrate shall thereafter be primed using a high performance epoxy primer within a short time window approved by the manufacturer/supplier. The lining system manufacturer/supplier shall demonstrate a proven Quality Control system that monitors and documents the key physical properties, as described above.

8 HANDLING, STORAGE AND PROTECTION

8.1 Facilities

- 8.1.1 Contractor shall construct adequate facilities for the storage of material. Upon completion of fabrication, the contractor shall remove the fabrication facility from the site and return the area to the pre-construction condition.
- 8.1.2 The installation of borosilicate lining system must be done in a suitable environment (temperature, humidity etc. control as per manufacturer recommendation to stand by the required guarantee). Maintenance of the required suitable condition and any tools/tackles, machinery required to maintain the controlled environment during installation of borosilicate glass block shall be in the scope of contractor.

8.2 Storage

- 8.2.1 Materials shall be stored in a dry area and within the temperature and humidity limits recommended by the manufacturer/supplier. Do not allow shelf-life limits, as determined by the manufacturer/supplier, to be exceeded.
- 8.2.2 Materials surfaces shall be protected from dust, fog, rain and other contaminants.
- 8.2.3 Affected materials shall be removed if any of the above requirements are not met.

9 JOB SITE INSPECTION AND PREPARATION

9.1 In coordination with the chimney contractor the borosilicate glass block lining system installation agency should submit a plan detailing the application sequence and methods to be employed, including moving, handling, storage, erection, fit up and the methods to be used for environmental protection.

ANNEXURE-I

OPERATING CONDITIONS (Per FGD Absorber)						
DESCRIPTION / LOAD		Guarantee Point	Design Point			
		TMCR	BMCR			
Flue Gas Flow	t / h	2894.995	3052.550			
Flue Gas Volume	m ³ / s	721.2244	766.3178			
Flue Gas Temperature	°C	48.8	49.8			
Flue Gas Density	kg / m ³	1.115	1.1065			
FGD OUTLET-FLUE GAS COMPOSITION % BY VOLUME – (WET BASIS)						
CO ₂		14.62	14.33			
N ₂		71.08	69.78			
O ₂		2.94	3.34			
SO ₂		0.0055	0.0052			
H ₂ O		11.35	12.54			



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TECHNICAL SPECIFICATION FOR WET STACK
FLOW MODEL STUDY
2 X 500 MW NTPL TUTICORIN (CHIMNEY
PACKAGE)

SPEC. NO.: PE-TS-490-142-N102

VOLUME: I

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ENCLOSURES:

Annexure-I: Project information

Annexure-II: Flue gas process parameters

Annexure-III: GA of chimney

Annexure-IV: Minishell

Annexure-V: FGD Layout

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1.00.00 INTENT OF SPECIFICATION:

The intent of this enquiry/ specification is to carry out the Wet stack flow model study of 2 x 500 MW NTPL TUTICORIN (CHIMNEY PACKAGE) project for complete duct system from absorber outlet to the top of the stack, design and optimization of gas flow and liquid collection system to mitigate stack liquid discharge (SLD) and shell corrosion, Preparation of final report and recommendations, preparation of drawings/ documents for execution of collection system, obtaining approval on documents from BHEL/ Customer/ customer's consultant, Preparation of BOQ, preparation of bought out item specification, procurement assistance for specialized items, site visit as specified later in the specification & as necessary for completeness in all respects and for efficient & trouble free operation of chimney and liquid collection system for project.

2.00.00 SCOPE OF WORK:

Wet stack model study shall consist of the following:

- Condensation calculations & design of optimized condensate collection system
- A scale physical flow model for liquid collector system (LCS) design.
- A computational flow model for plume downwash analysis.
- A physical or computational flow model for CEMS elevation flow performance.
- Design of optimum choke geometry, if required.
- Review & Approval of liquid collector system construction drawings.
- Site inspection & supervision for 7 days to verify and evaluate LCS system performance prior to commissioning.

Wet stack study shall be performed for each unit with a wet stack installation where there does not exist an identical or mirror image installation. The objective of the wet stack study shall be to maximize liquid collection downstream of the mist eliminators and to preclude ground level rainout from the stack by recommending experimentally developed, tested, and optimized liquid collection devices and drainage systems to return collected liquid to the absorber with minimum re-entrainment.

The following codes and standard shall be followed for the conductance of this study:

- Revised wet stack design guidelines, 2012 by EPRI
- ACI 307 (American concrete institute code requirement for RC chimney
- EPRI report CS-2520 Entrainment in wet stack 1982
- EPRI report TR 107099 Wet stack design guide 1996
- EPRI report TR-109380 guidelines for fluid dynamic design of power plant ducts, 1998
- EPRI report GS-6984 FGD mist eliminator system design and specification guide



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- CICIND, ICAC, US EPA and other international and other latest codes and standards.
The study shall be carried out by design methods and tools:
- Preliminary design review based on experience
- Laboratory flow modeling -3-D
- Computer flow modelling -3-D
- Computer program calculations – 2-D

Bidder to furnish the recommendation for LCS with most optimized design (i.e. recommended number, location, type etc. of gutters, collectors and other components). BHEL reserves the right to accept the design or suggest further changes in the design based on techno-economic analysis. Bidder shall implement the changes suggested by BHEL without any commercial implication and final design shall be subjected to BHEL's approval during contract stage, in the event of order.

2.01.01 Preliminary design review based on experience

Based on the inputs furnished as per enclosed Annexure with this specification for the duct work and stack, preliminary design review need to be carried out to estimate the liquid collection requirements, predict the condensation rate in the duct & stack and perform the preliminary system design.

2.01.02 Condensation calculations using analytical / numerical tools

Gas flow study should include the calculation for the condensate formed and / or condensate carry over. The condensate flow study should include condensate quantity formed due to:

- i) Thermal condensation on the liners
- ii) Adiabatic condensation
- iii) Turbulence of flue gas flow near entry of the stack
- iv) At the outlet duct from absorber mist eliminator outlet
- v) Contribution from mist eliminator carryover in case of normal wash cycle or mist eliminator become fouled with time.

Detailed calculations along with the design basis for condensation rate in the duct from absorber outlet to the top of the chimney for the worst operating case, minimum boiler load and design conditions shall be furnished as a function of ambient air temperature, wind velocity and liner design variables in the report with an accuracy of $\pm 10\%$.



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2.01.03 Design of Condensate collection & drainage system

- (i) Size of gutter(s) along with inner surface of Chimney flue can and inlet duct from absorber outlet to inlet of chimney flue can, such that condensate is collected efficiently and drained off with a drainage system till its terminal point at ground outside the duct & Chimney shell.

- (ii) As the gutter shall be made of Titanium/C-276 as compatible with inner surface, suitable shape, size and thickness is to be recommended so that gas flow occurs efficiently. Drawings shall include the details such that manufacturing/fabrication of condensate collection system/gutters/guide vanes etc can be done by BHEL/BHEL's vendor.

- (iii) The size, thickness, location and material of condensate drainage pipe shall be included in recommendation. It is envisaged that pipe from gutter to outside of Chimney liner shall be of Titanium/C-276 and thereafter the drainage pipe shall be of FRP up to the collection pit. Routing of the drain pipes shall be provided.

After the flow-model study is performed, accordingly design of liquid-collection devices for the full scaled Wet Stack is to be carried out and detailed drawings, design basis and calculations shall be submitted.

2.01.04 Computational 3-D fluid-dynamic-model study (CFD Analysis)

Performance of a computational 3-D fluid-dynamic-model study of the minimum upper one third of the stack liner and shell to evaluate downwash of the wet plume. CFD model shall include the surrounding structure which are significant to wind/ plume flow patterns preferably minishell, external handrails and floor at the stack outlet.

A computational model of the stack shell and liner(s) shall be constructed for the plume downwash study. The plume downwash study shall include analysis of the local wind/temperature data to identify the occurrence of critical wind and temperature conditions. The plume downwash study shall identify the stack velocity and ambient wind conditions that produce downwash and the maximum extent of expected downwash throughout the year for shell corrosion protection. For sites where ambient temperatures reach freezing, a "winter" period shall be simulated to evaluate icing potential on the stack.

Depending on the results of the downwash study, there may be a need to develop an optimum choke geometry, if required, to minimize the plume downwash & liquid



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impingement of the shell. This includes evaluation of liquid collectors and drains to prevent re-entrainment and discharge of large droplets from the top of the choke.

Bidder to use the latest software for the CFD modelling and shall submit the model along with results in form of contours and vector plots of velocity, pressure, concentration and temperature at various test locations and summarized in tabular format. The model shall be tested with various simulated operating, minimum and design flow conditions, maximum wind speed, wind orientations, to evaluate the potential of the downwash.

The Bidder shall review Minishell details (Liner extension above roof) enclosed as an Annexure and confirm the liner-extension design with their recommendation.

In case of the excessive downwash or reversed flow at stack exit or liquid exiting the stack liner and forming on the top of the concrete shell, bidder to provide the corrective actions, design modifications and evaluate the modified geometry.

2.02.00 Physical model of the system

An experimental gas-flow-model study to design and develop collectors for the duct and stack downstream of the mist eliminator that will collect and drain liquid from the walls to prevent re-entrainment.

Laboratory Physical model study shall include the following details for wet stack design:

- i. Estimation of the total liquid load on the liner surface as a result of thermal and adiabatic condensation. This estimate shall be based on the liner and shell geometry, thickness, materials of construction and the flue gas-flow rate and properties over a range of expected plant-operating conditions and worst-case ambient weather conditions considering the mist eliminator fouling / wash cycles.
- ii. Design and optimization of liquid collectors in the absorber-outlet hood, absorber-outlet ducts, stack-liner entrance region and stack liner outlet to prevent SLD. The collectors will collect liquid from surfaces, re-entrainment, and guide the liquid to locations where it can be drained out of the system. This development work shall be conducted on a scale model of the wet duct and stack system, from the outlet of each absorber's mist eliminator to four diameters of stack-liner above the top of the breech or inlet duct. Model scales shall be minimum 1:12 and to be selected to ensure



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accurate modeling results for all tested parameters. The same shall be finalized after the award of the contract. The design should be of integrated complete system of liquid collectors from absorber outlet to chimney top for each unit.

- iii. The laboratory test includes details of liquid re-entrainment and drainage behavior over the expected range of unit operating conditions and confirm the stack-liner design velocity.
- iv. Physical model shall include any internal devices larger than 3 inches in diameter/protrusion that may affect the flow, such as structural members, internal dampers, flow controls, and expansion joints. The model shall be mainly constructed from transparent acrylic or plastic, sheet metal, or coated rigid tubing such that it is suitable for wet testing. Modeled flow control and liquid collection devices may be constructed with sheet metal, or other suitable construction materials, so long as the scaled liquid flow performance is not adversely modified.
- v. The physical model shall be tested for pressure and velocity profiles at selected cross sections through the ducts and liner. A velocity traverse shall be conducted within the modeled liner to ensure that the cyclonic flow levels are within the U.S. EPA Method 1 recommended limitations for CEMS operation. In the event testing indicates that cyclonic flow could be a concern at the continuous emissions monitoring system (CEMS) elevation, a simulation, either by extension to the physical model or using a computational fluid dynamic model, shall be performed to evaluate this flow at the CEMS level. If needed, corrective devices shall be designed and tested to reduce stack swirl at the CEMS elevation.
- vi. The physical model shall be tested by introducing liquid in a size and quantity such that the model shall approximately match the two-phase flow modeling requirements for droplet trajectory and loading. This testing shall be used to locate and design the liquid collection devices and drains.
- vii. Evaluation of re-entrainment at liner-expansion joints in the laboratory test rig and development of a unit-specific liquid-collector geometry to collect and drain the liquid from the liner-expansion joints.
- viii. Using this model effective internal liquid collection devices shall be developed and optimized to improve the droplet deposition and liquid collection in the stack as well as to prevent the re-entrainment of droplets from liquid pools and films.



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- ix. Bidder shall submit the detailed standard procedure for carrying out the physical model study at vendor lab for customer information / approval before the conductance of physical model study at lab.

Site inspection & supervision

Bidder to perform an onsite inspection as per the EPRI Revised Wet Stack Design Guideline, 2012. Site visit should occur for 7 days time during the construction phase, when liquid collection system is nearing completion, to inspect the liquid collection system as installed to ensure that the designed flow controls, liquid collectors, drains, and drain protection are installed properly and shall perform as intended. Bidder to provide the site inspection report to validate the design and installation.

The onsite inspection should confirm that the liquid-collection system has been fabricated and installed correctly and to identify any deviations to the recommended design as a result of field modifications made to ease installation. The bidder shall also ensure the liquid collection system is installed properly.

The key deliverables from this study are:

- a) Bidder to furnish the total quantity of condensate formed from absorber mist eliminator outlet to top of the stack.
- b) Bidder to furnish the number, sizing and location of required various liquid collectors/gutters, their shape, design of its evacuation piping from inside the chimney to outside and their Influence on the flow in the chimney liner.
- c) Flow model study shall minimize system pressure losses and optimize collection and drainage and provide expected field wet stack system pressure loss across expected load range.
- d) Bidder to achieve minimum stack liquid discharge. In case of excessive stack liquid discharge, possible means of modification to duct and stack geometry need to be proposed by bidder for improvement.
- e) Bidder to ensure the design of effective liquid collection system for various plant load operating conditions and absorber combinations.
- f) Bidder to recommend modifications to prevent the chimney liquid discharge issues and to make the geometry more favorable for liquid collection.



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- g) Bidder to furnish the fabrication/installation drawings after the completion of model study for fabrication.
- h) Bidder to identify appropriate liner system and gas inlet geometries (including flow control devices) to ensure homogeneous gas flow conditions and achieve cyclonic free flow distribution at the CEMS location.
- i) Bidder to provide recommendations and design for sealing drain piping/ seal pots to inhibit backflow.
- j) Bidder to recommend drain protection devices to minimize pluggage occurrences an flow and recommend method for monitoring liquid collection drainage flow in case of liquid collection system pluggage and SLD problems.
- k) Bidder to provide stack outlet modifications, such as liner extensions or chokes, to minimize stack icing occurrences and to provide Stack shell coating requirements to protect concrete shells from corrosion due to plume downwash.
- l) Bidder to evaluate the plume downwash and recommend modifications to minimize downwash using CFD model preferably at reduced unit load operation and high wind speed conditions.
- m) Bidder to provide the drawings/documents for the necessary provisions in Chimney during the course of this study, if applicable, to carry out the performance test for wet stack at site in future.



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Customer Specific Technical Requirements



forces (due to dynamic interference effect) as calculated based on relevant codes, shall be considered in the initial designs. Worst of the forces calculated as per as per codal requirements and forces obtained from wind tunnel study shall be considered as design forces for final design of shell and foundation. Wind tunnel study has to be done in any one of the following approved labs – SERC-Chennai, IISc-Bangalore and IIT-Kanpur and the study report shall be got approved by the owner / Consultant. The model test shall be duly witnessed by the owner and the Consultant.

The flue ducts shall be entering as per layout given by FGD Package vendor.

Refer to Vol-II-B Sec-I - Part B - Sub Section-II of this specification for Guideline for Construction of RCC Bi-Flue Chimney.

The area around Chimney for 5m width shall be RCC paved except for the portions if already paved. Wherever existing paving is dismantled during construction activities shall be restored with RCC paving at the possible locations.

1.02.00 General parameters of the chimney

Total height of the chimney above FFL	:	150 m.
RCC Wind shield (shell) enclosing Two steel flues, one for each Boiler.		
No. of Boilers.	:	Two
Particulate emission	:	30 mg/Nm ³ (approx)
Volume of Gas (at NTP 0 ° C and 1.013 bar)	:	734.791 Nm ³ /sec * (per flue)
Temperature of flue gases.	:	60° C *
Acid dew point	:	75° C *
Flue gas pressure at Chimney entry level.	:	10 mm WC * (To be considered as NIL for stack sizing)
Stack Exit velocity	:	Maximum 18.3 m/s (With Borosilicate block lining as per latest EPRI guidelines)
Note: The parameters marked with asterisks (*) are indicative only.		
Inlet-duct Center line elevation.	:	During Detail
Duct opening Dimensions.	:	Engg. Stage
Minimum top internal shell diameter.	:	To be decided by Bidder
Minimum bottom internal shell diameter	:	To be decided by





Bidder

** The bidder shall use the borelog data of Owner's Existing Soil Investigation Report for reference purpose. Moreover, bidder is at liberty to carryout suitable number of borehole tests at site to assess the pile capacity values for pile foundations and the Net Safe Bearing Capacity values for open foundations prior to quote. After contract award, the design of foundations shall be carried out as per the provisions of IS-456 & IS-2911. The design, type, size, depth of the foundation shall be based on the approved soil investigation report of the successful Bidder/Owner's soil investigation report whichever is conservative.

1.03.00 The windshield shall be of RCC construction. Two nos. of steel flues shall be housed within the windshield. Flues shall be supported on the top of platforms. Platforms shall be provided at regular interval. The flue ducts shall be entering as per layout given by FGD Package vendor.

1.04.00 All internal platforms shall be supported on R.C. shell of the wind shield. Internal structural steel staircase for access to all platforms shall be provided. Rolling shutter (electrically operated) and one Steel Door at grade floor level shall be provided for access into the windshield and on to the platforms. All doors like inspection/ maintenance doors shall be as per IS code / environment regulation.

1.05.00 Natural Ventilation within the windshield shall be provided as required.

1.06.00 **Process Criteria for Wet Chimney**

i) Treated flue gas from the absorber shall be discharged through the chimney flues. The wet flues of chimney shall be suitably lined. The flue duct shall be lined with 51 mm thick Borosilicate glass blocks . External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium sheet. The design & construction of steel chimney liners shall be based on the guidelines of EPRI Revised Wet Stack Design guide.

For bypass condition, existing 275m high Chimney will be utilized.

ii) Wet Chimney Condensate Collection System

To avoid the carryover of the condensate/acidic dews/water droplets/ gypsum coming out of the wet chimney a condensate collection system shall be provided. Design of the condensate system should be such that the liquid condensate film near the exit of the stack is collected in the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the nearby area.

iii) Wet stack flow model study





A wet stack flow model study shall be performed by the Contractor or by the Sub-Contractor (who satisfy the requirements as specified in Vol II A. Section III Annexure-1 Acceptance criteria for Sub-contractors) for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed for this project. A wet stack model study shall consist of the following:

- a) Condensation calculations.
 - b) Minimum 1:12 scale physical flow model for liquid collector design.
 - c) Computational flow model for plume downwash analysis.
 - d) Physical or computational flow model for CEMS elevation flow performance.
- iv) Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), including the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to drain out to the ground before evaporation.
- For the model studies, sharing of the necessary input and result details with the FGD vendor shall be considered for reiteration of model study and finalizing the ducting and flue can design.
- v) A common Nickel based alloy material storage/neutralizing tank for both the units of storage capacity of as per mechanical requirement of condensate from both the flues shall be provided complete with neutralizing chemicals dosing, mixing and preparation system. The neutralized condensate shall be pumped to common drain system by pumps as per mechanical requirement, complete with valves, piping and fittings, level control and monitoring etc. All the equipment, piping and fittings in contact with the condensate shall be of suitable material for the operating duty. The condensate collection system in this package includes condensate from FGD outlet up to flue can top.
- vi) All chimney condensate collection equipment shall be easily accessible for O&M. The design of the stack condensate collection system including that are covered under model study shall be provided by successful bidder. The Laboratory where the condensate collection



visit to the site, before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained/ collected by the Bidder.

3.2.0 APPROACH TO SITE

The site is accessed by National Highway No. 7A adjacent to plant. Due South connecting Madurai. The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km. Tuticorin sea port is located adjacent to the plant. Nearest airstrip is located at Pudukottai at a distance of 16.5 km. Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, 60 km away from the plant.

3.3.0 SALIENT METEOROLOGICAL DATA

For the purpose of equipment design, the following Meteorological data of site (as per IMD Tuticorin) shall be taken into consideration

- | | | |
|--------------------------------------|---|--|
| a) Ambient temperature | : | 36.5 °C maximum
20.8 °C minimum |
| b) Extreme Ambient temperature | : | 36.4 °C maximum (Annual)
24.1 °C minimum (Annual) |
| d) Relative humidity | : | |
| (i) Maximum | | 82% |
| (ii) Minimum | | 35% |
| (iii) Average | | 57 to 68% |
| e) Annual Rainfall | : | 437 mm |
| f) Wind load
(refer Vol-IIB also) | : | In accordance with IS-875, Part-3 |
| g) Seismic Zone
edition. | : | Zone II as per IS: 1893 latest |
| h) Altitude | : | 1.46 M above MSL |

4.00.00 SCOPE OF SUPPLY AND SERVICES

4.01.00 CIVIL WORKS

All Civil and Structural works for One (1) no. RCC Bi-flue Chimney 150 m high twin flue with borosilicate lining enclosed by RCC windshield to suit MOEF norms with Internal & External Platforms, ladders for access to roof top, Rack





TITLE: TECHNICAL SPECIFICATION FOR WET STACK FLOW MODEL STUDY 2 X 500 MW NTPL TUTICORIN (CHIMNEY PACKAGE)	SPEC. NO.: PE-TS-490-142-N102
	VOLUME: I
	SECTION:
	REV. NO. 00 DATE 01.02.2022 SHEET 10 OF 15

2.05.00 GENERAL

- a) Bidder to furnish the detailed Master drawing list for wet stack flow model study for BHEL and customer approval.
- b) Bidder to provide technical advice/ recommendations/ assistance & solutions regarding site related construction problems related to condensate collection and drainage system in the duct and chimney as and when required including site visits, participation in meetings through VC/WEB with BHEL/ customer/ customer's consultant.
- c) The physical model study may be witnessed by BHEL / Plant Owner for approximately 3 days. Intimation for the witnessing shall be provided by the bidder 4 weeks prior to conductance of physical model test at vendor lab. Video streaming facility shall also be provided for witnessing the physical model test from India. In addition, complete physical model test including the flow patterns and droplets trajectory shall be recorded on video CD/pen drive, which shall be provided after the physical model study.
- d) The physical model shall be stored at the vendor lab at no cost for a period of 1 year after the submission of final report and completion of the study. Thereafter its further disposal or storage shall be decided after the award of the contract on the cost basis. Optional prices may be quoted for the same and this shall not be considered for the evaluation of bid.
- e) The bidder is advised to take care all information that may be necessary for preparing the bid and entering into the contract. Claims of any kind due to variation or ignorance of site conditions and environmental conditions after award of works will not be entertained.
- f) All revisions/changes required as per BHEL/ Project owners, comments/ requirements, site requirement etc. shall be carried out by the bidder.
- g) Three hard copies of approved reports/documents/drawings shall be submitted by the bidder. Electronic copies of the CFD model, analysis and report shall be submitted in 3-D viewable format as well as in printable non-proprietary formats (e.g. .pdf).
- h) Change in recommendation / design after the analysis shall be taken care by bidder without any commercial implication in this contract value.
- i) Bidder shall furnish detailed activity schedule, report generation schedule and list of inputs required for successful execution of Wet stack flow model study.



TITLE: TECHNICAL SPECIFICATION FOR WET STACK FLOW MODEL STUDY 2 X 500 MW NTPL TUTICORIN (CHIMNEY PACKAGE)	SPEC. NO.: PE-TS-490-142-N102
	VOLUME: I
	SECTION:
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SHEET 11 OF 15	

- j) The Purchaser/ Customer however also reserve the rights to check the detailed calculations in the event of order and their interpretation shall be final in the event of any conflict.
- k) Bidder shall furnish all the documents in English and SI units shall also be followed in the calculations and reports wherever used.

3.00.00 BID EVALUATION CRITERIA

Bidders should quote prices as per format (price schedule) enclosed in the tender document. Bids shall be evaluated based on the total price quoted for Wet stack flow model study work as per this specification.

4.00.00 DELIVERY SCHEDULE

Bidder has to carry out the complete activity including physical model, CFD, drawing /documents and final report approval by BHEL and plant owner within 15 weeks from the date of purchase order/firm inputs.

5.00.00 SUGGESTIVE DRAWINGS/ DOCUMENTS SUBMISSION:

Following Basic drawings/documents to be submitted within 2 weeks from LOI date.

1. MASTER DRAWING /DOCUMENT LIST. (to be finalized after order)
2. WET STACK STUDY SCHEDULE
3. STANDARD PROCEDURE FOR STUDY.

Following Basic drawings/documents to be submitted and approval shall be obtained within 15 weeks from LOI / firm inputs date.

1. TECHNICAL DATASHEETS, IF ANY.
2. WET STACK CONDENSATE FLOW MODEL STUDY REPORT (INCLUDING THERMAL AND ADIABATIC CONDENSATION CALCULATIONS WITH DESIGN BASIS, DESIGN DRAWINGS OF CONDENSATE COLLECTION AND DRAINAGE SYSTEM)
3. CFD FLOW MODEL STUDY RESULTS/REPORT

This is not an exhaustive list of drawings/ documents for WET STACK STUDY.



TITLE: TECHNICAL SPECIFICATION FOR WET STACK FLOW MODEL STUDY 2 X 500 MW NTPL TUTICORIN (CHIMNEY PACKAGE)	SPEC. NO.: PE-TS-490-142-N102
	VOLUME: I
	SECTION:
	REV. NO. 00 DATE 01.02.2022
SHEET 12 OF 15	

Bidder shall furnish all applicable drawings /documents other than as mentioned above which is/are required for successful execution of condensate collection and drainage system after the absorber outlet to stack outlet.

NOTE:

1. Subsequent revisions of above drgs/docs to be submitted within 7 days of comments received from BHEL/ CUSTOMER.
2. Drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays to bidder's account.

6.00.0 OTHER TERMS OF CONTRACT

The contract will be awarded on Lump Sum Basis and no claims will be acceptable due to any reason whatsoever. The reports / design and drawings prepared by the bidder may be required to be revised / modified due to various reasons including site condition, engineering inputs, layout changes and CUSTOMER's requirement. The quoted rate shall be inclusive of additional effort to take care of such revisions.

7.00.00 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- a) Detailed procedure adopted for the conductance of the study.
- b) Wet stack study planning and scheduling.
- c) Computer program to be used for the 3D modelling and analysis.
- d) Mathematical tools & codes / programs used for the analytical calculations.
- e) Technical deviation schedule (if reqd.) (enclosed herein)

Apart from above no other drawings/documents/data sheets etc. are required to be submitted at bid stage and even if furnished, shall not be taken cognizance of.



SECTION – 2

GENERAL PROJECT INFORMATION

2.0 GENERAL PROJECT INFORMATION

1	Owner / Purchaser	NLC Tamil Nadu Power Limited (NTPL) (A Joint Venture Between NLC INDIA LIMITED and Tamil Nadu Electricity Board)
2	Project Name	NTPL Tuticorin Thermal Power Project
3	Capacity and Configuration	1000 MW [2 x 500 MW]
4	Owner's Consultant	Development Consultants Private Limited
5	Geographical Location	Latitude 8 ^o 45'38.09"North Longitude 78 ^o 10'15.85"East At Tuticorin Taluk in Tuticorin district in the Southern Part of Tamil Nadu along the Bay of Mannar, India
6	Access to site	
6.1	Nearest Airport	Nearest airstrip is located at Pudukottai at a distance of 16.5 km
6.2	Nearest port	Tuticorin sea port is located adjacent to the plant.
6.3	Nearest Railway Station	The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km
6.4	Nearest Town	Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallyamkottai, 60 km away from the Plant.
6.5	Nearest Highway	National Highway No. 7A adjacent to plant
7	Meteorological data	
7.1	Site Elevation	The natural land profile of the site 1.46 m above mean sea level
7.2	Ambient Temperature DBT	
i.	Maximum DBT	36.5 °C
ii.	Minimum DBT	20.8 °C
iii.	Performance DBT	27 °C
7.3	RELATIVE HUMIDITY	
i.	Maximum	82 %



Tender Specification
for
Chimney

NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu

ii.	Minimum	35 %
iii.	Performance	50%
7.4	Earthquake Zone	Zone II
7.5	Predominant Wind direction	East to West
7.6	Wind velocity	Civil/structural design will be done considering IS 875 part 3
7.7	Annual Rainfall	437 mm
7.8	Availability of Raw Water	Main source of water of the plant is sea water, which shall be taken from the Bay of Mannar.



FLUE GAS DUCT SIZING CALCULATION

BHEL Document No.

From Combined Duct to Absorber:

Flue Gas Flow Rate (As per Technical Specification)	m ³ /s	925
Velocity (As per Technical Specification)	m/s	15
Area required	m ²	61.7
Duct Sizing considered (WXH)	mxm	6.0 m x 10.4 m
Area Provided	m ²	62.4
Pressure	mmwc	150
Temperature	°C	147.5
Density	Kg/m ³	0.883

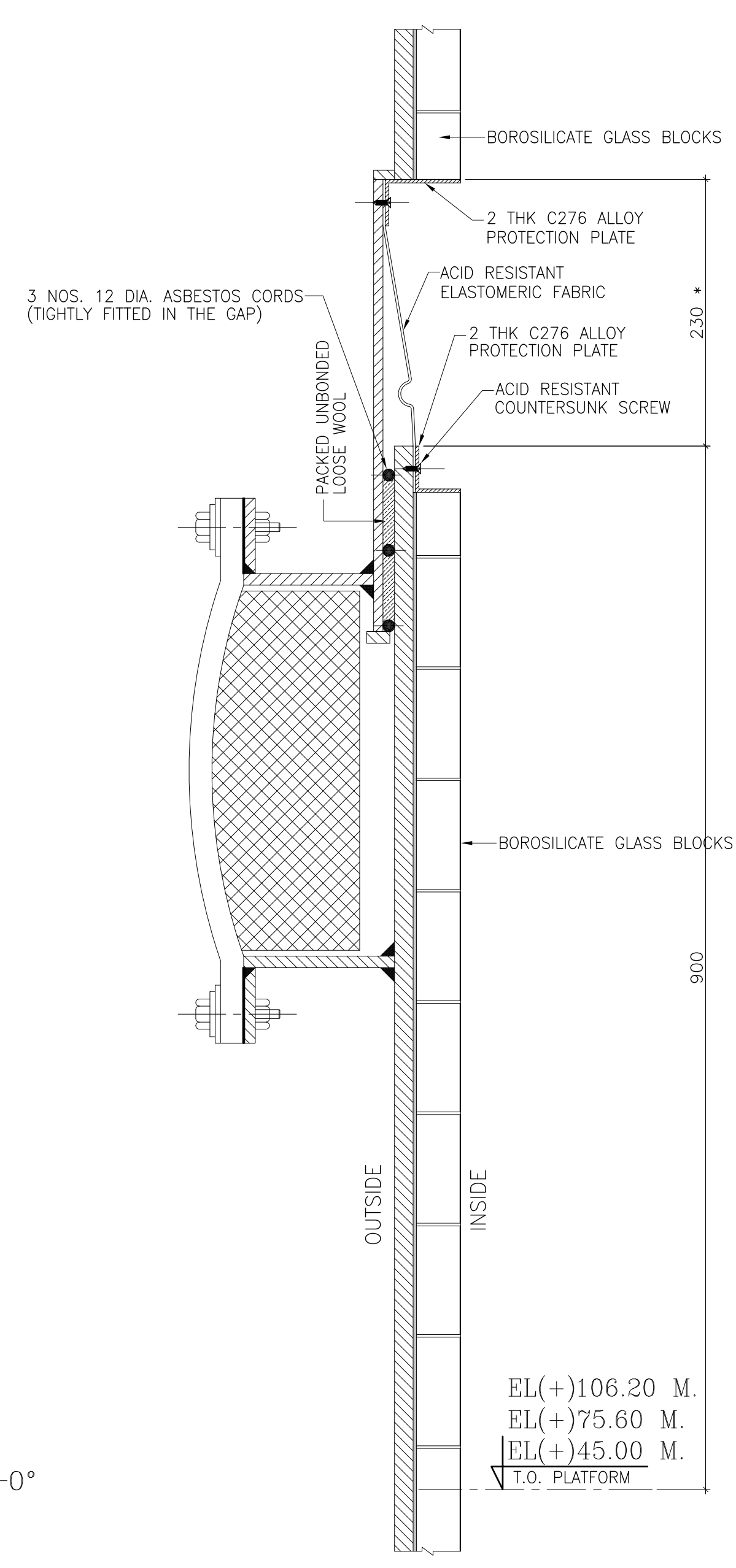
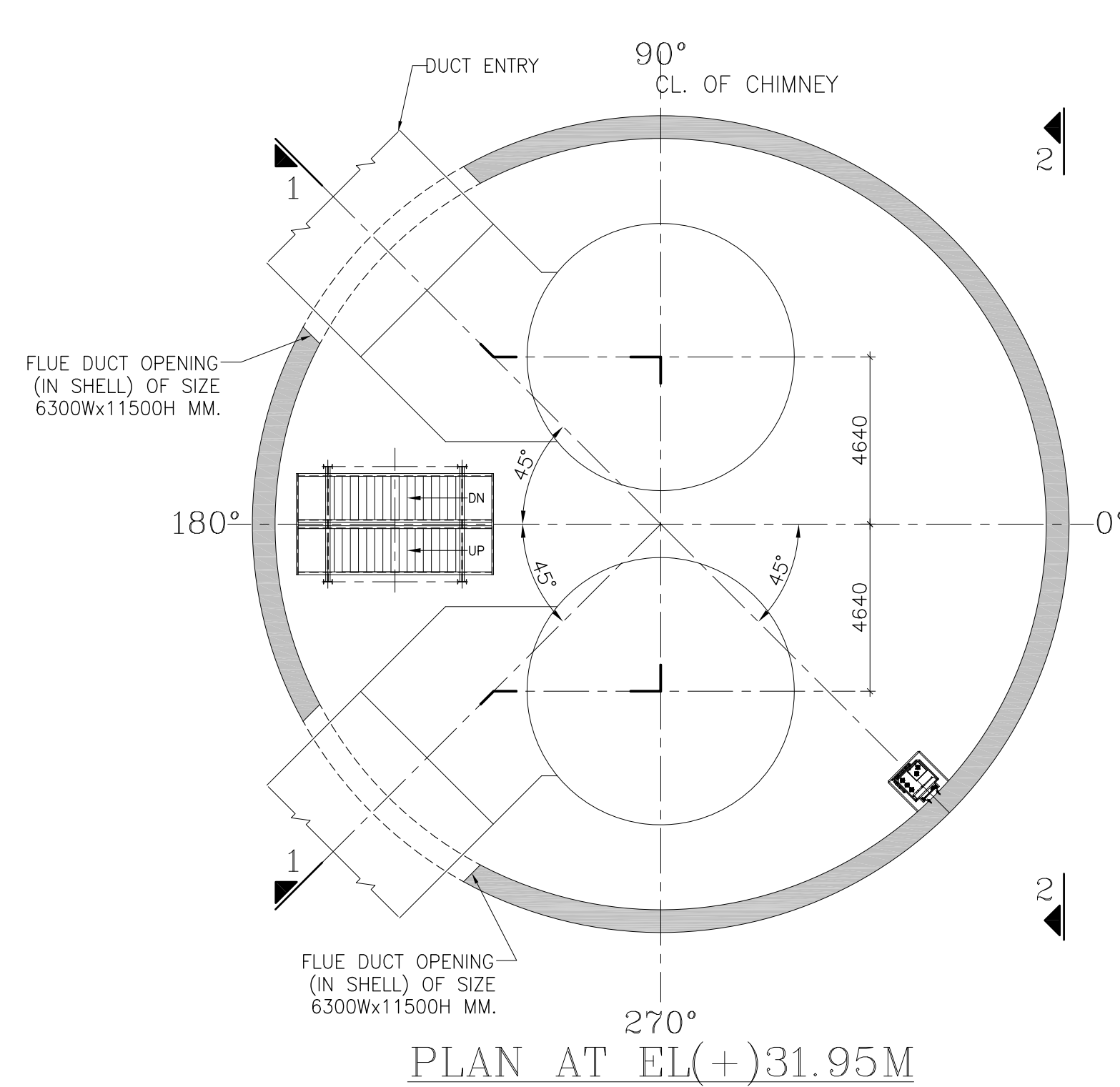
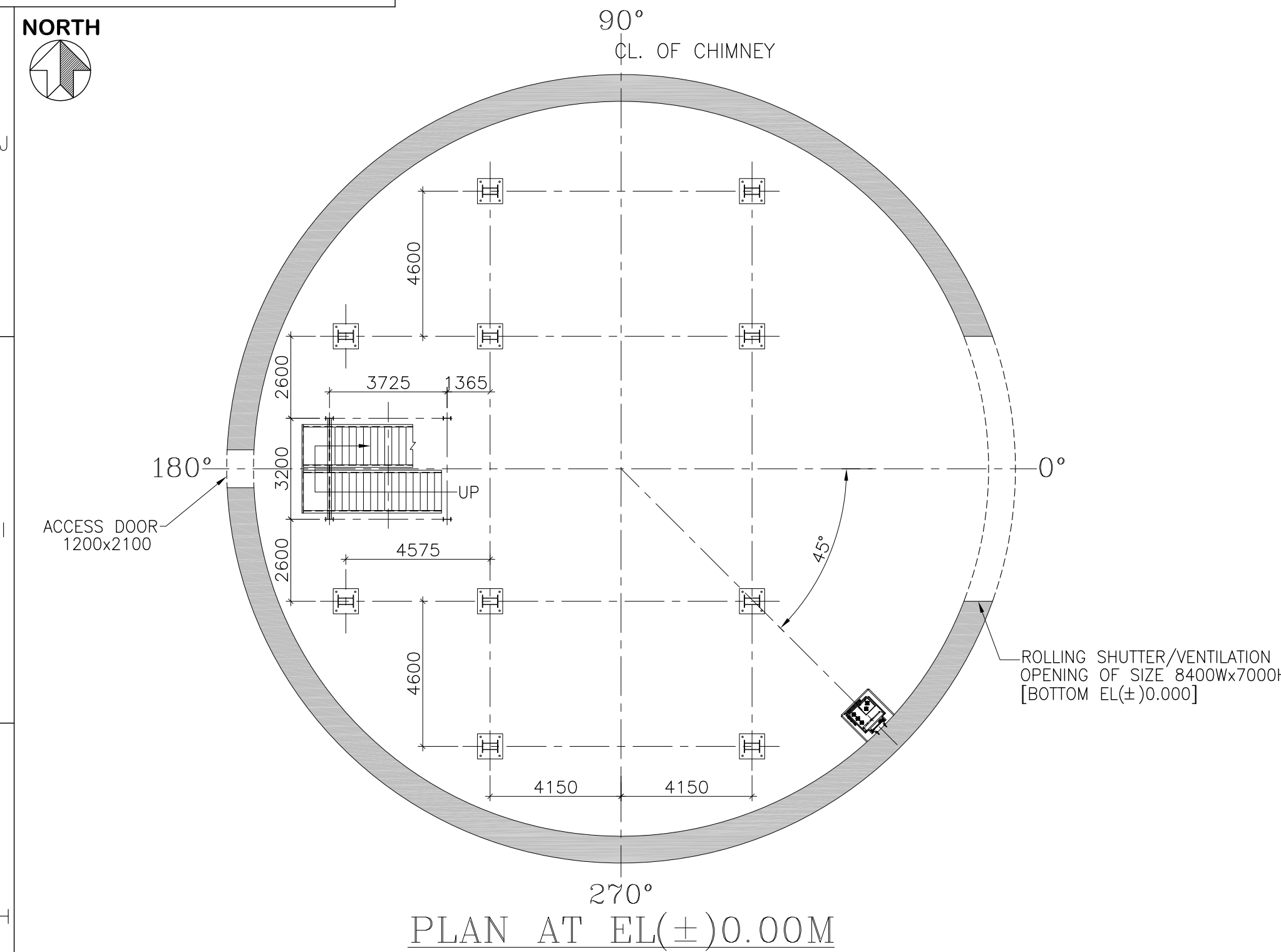
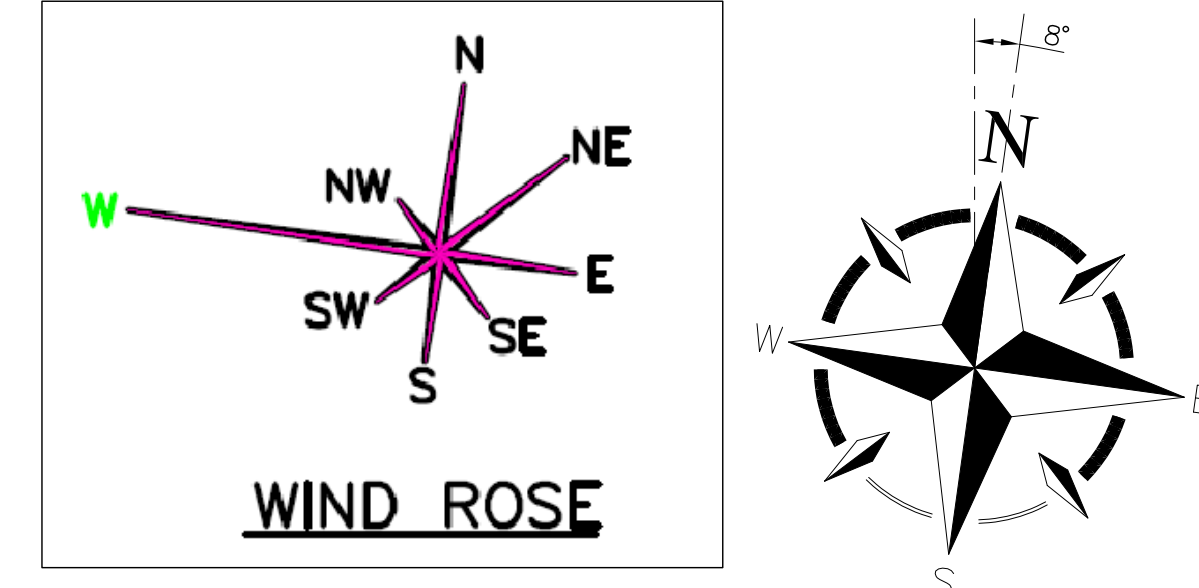
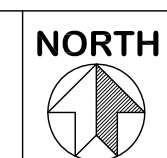
FGD Absorber to Chimney:

Flue Gas Flow Rate (As per Mass Balance)	m ³ /hr	27,58,744
	m ³ /s	766.3
Velocity	m/s	15
Area Required	m ²	51.1
Duct Sizing considered (WXH)	mxm	5.1 x 10.2
Area Provided	m ²	52.0
Pressure	mmwc	50
Temperature	°C	49.8
Density	Kg/m ³	1.1065

Annexure-VI: Expansion Joint.
Annexure-III: CA of Chimney
Annexure-IV: Minishell

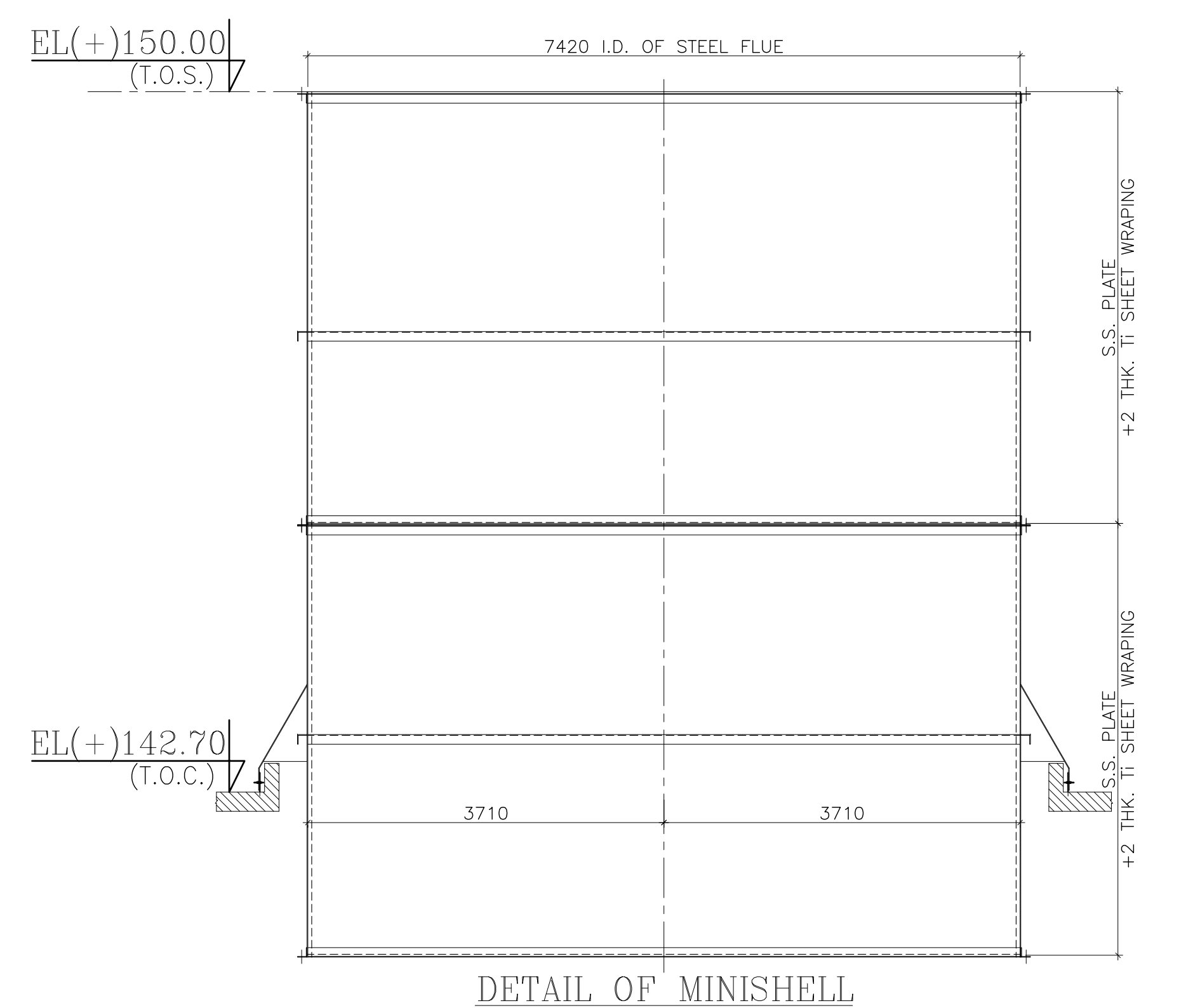
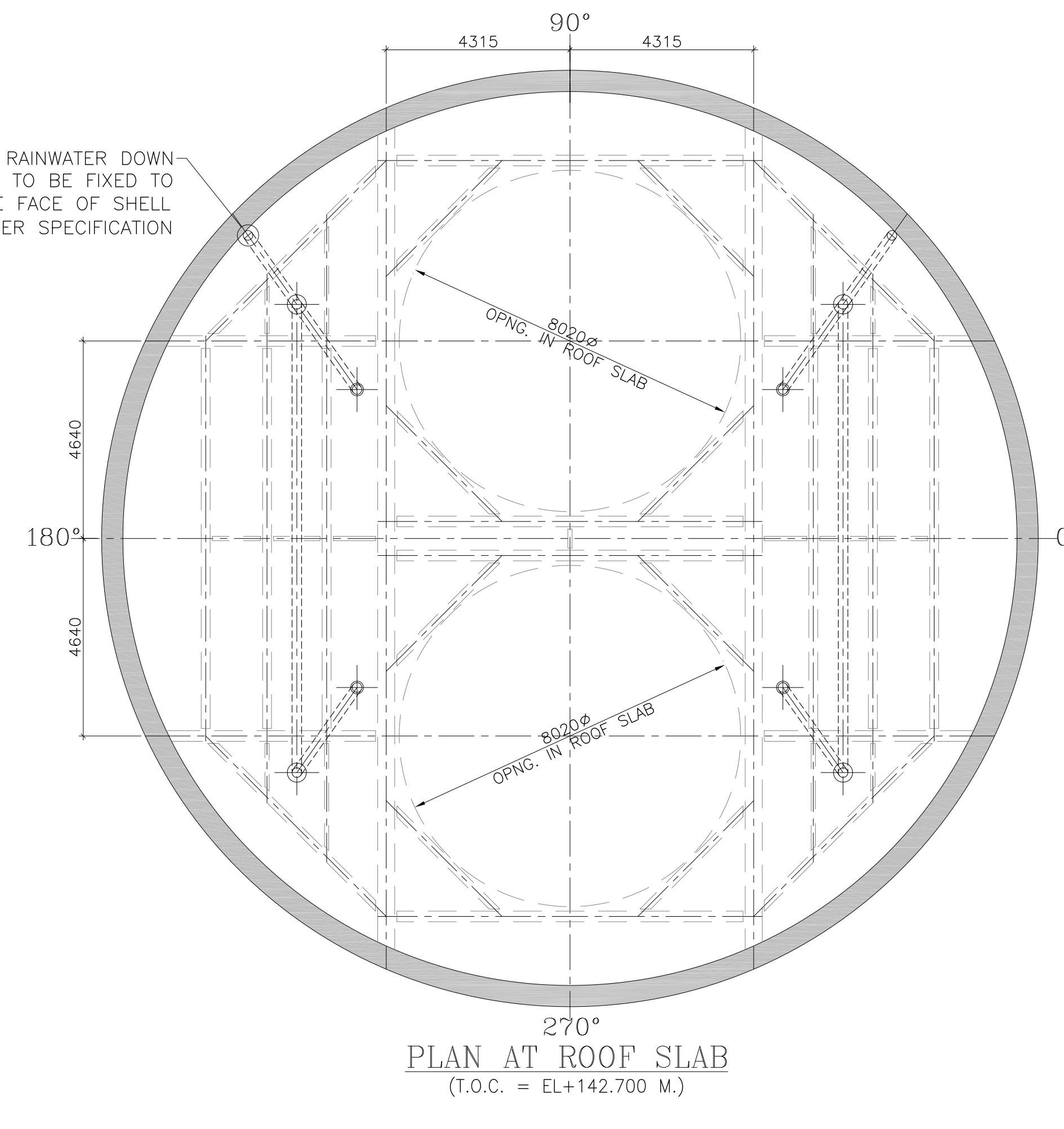
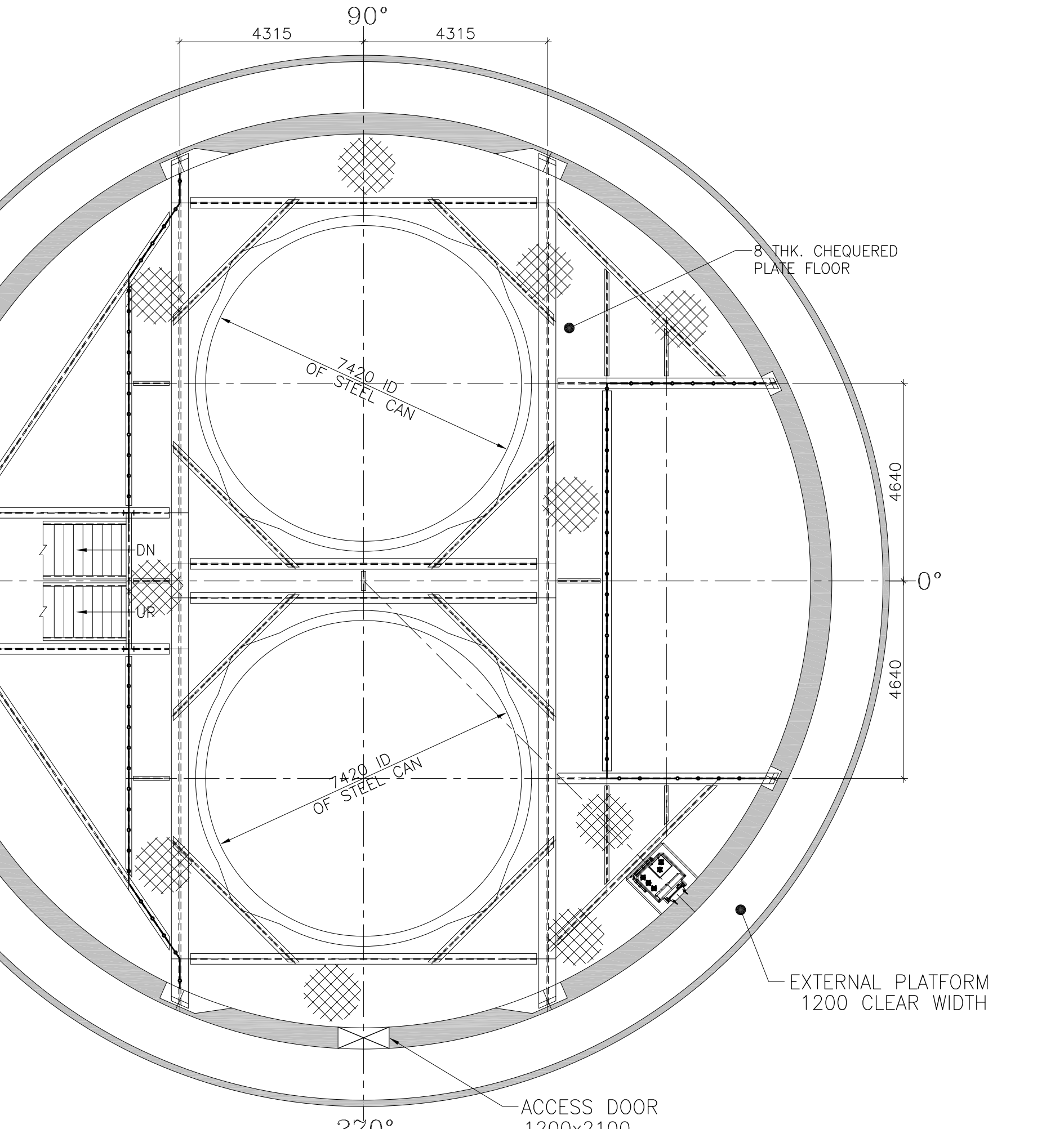
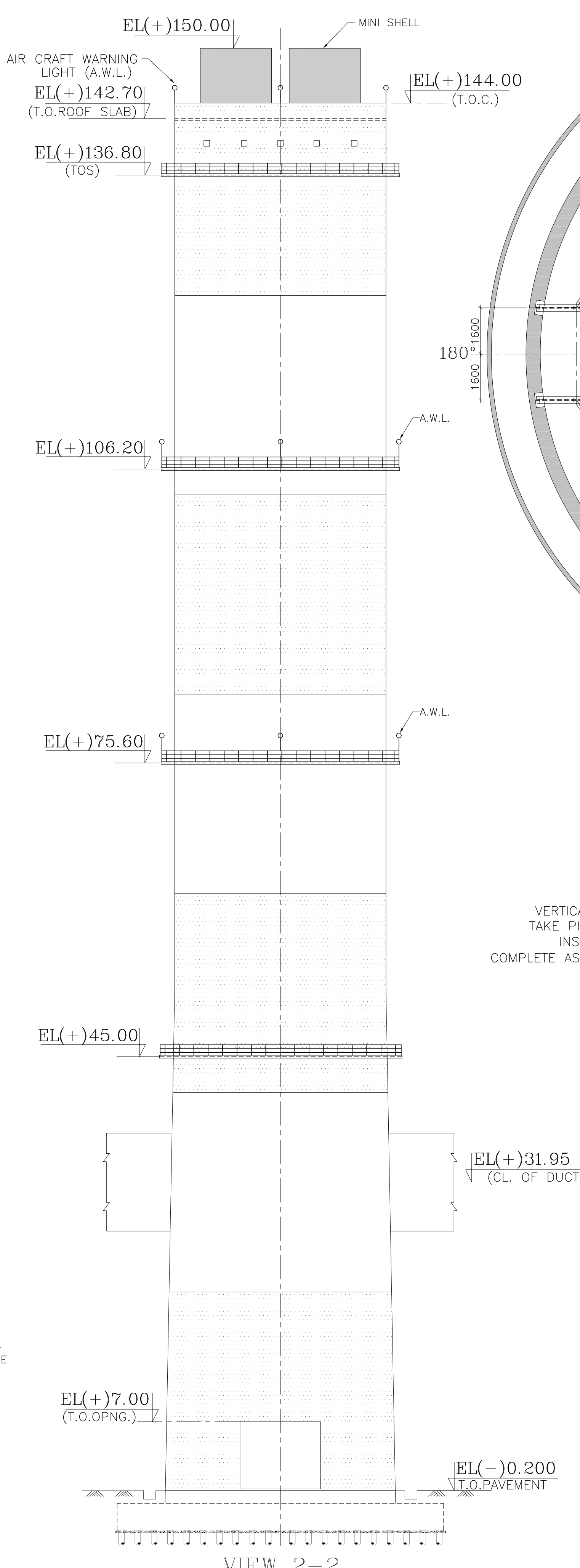
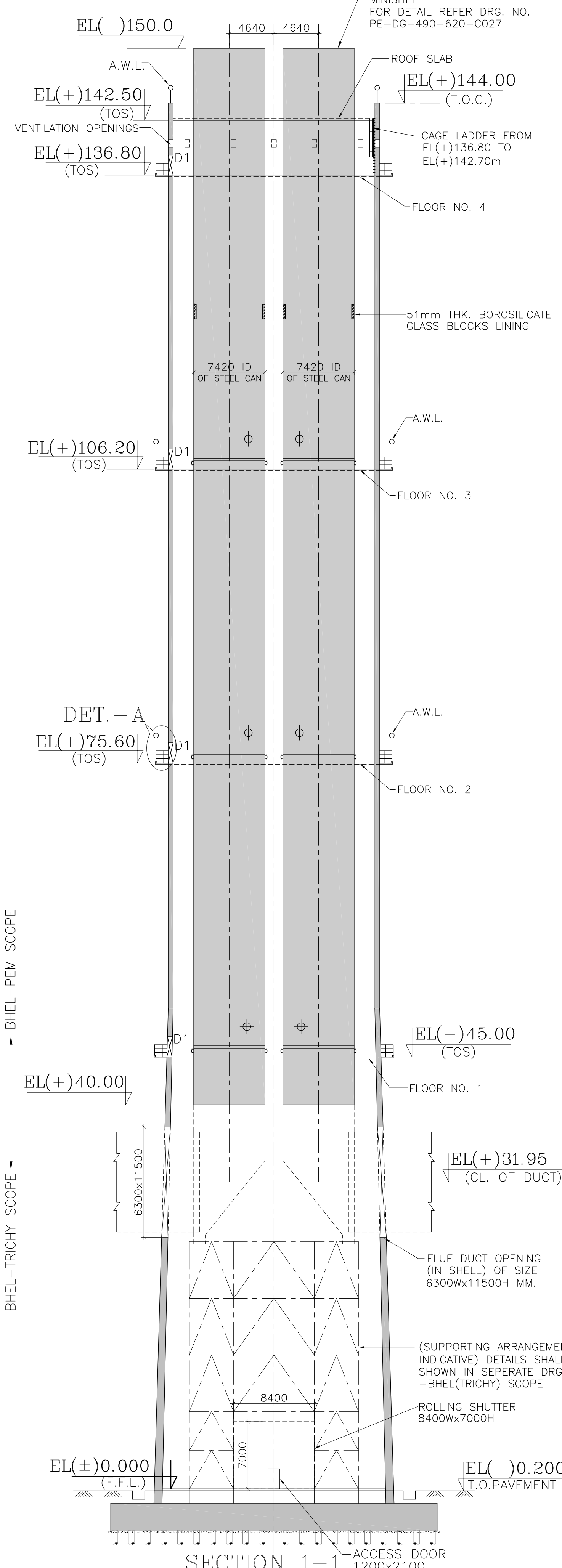
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



* DIMENSIONS PREFIRED ARE GIVEN FOR LINERS IN COLD POSITION AT TEMPERATURE 20°C. INSTALLATION AT ANY OTHER TEMPERATURE WILL RESULT IN VARIATION FROM THESE VALUES.

ELEVATION (M)	OUTSIDE DIAMETER OF SHELL (mm)	SHELL THK (mm)	OUTSIDE PROFILE OF SHELL (mm)
+144.00	22000	500	
+142.50	22000	500	
+140.00	22000	500	
+136.80	22000	500	
+130.00	22000	500	
+125.00	22000	500	
+120.00	22000	500	
+115.00	22000	500	
+110.00	22000	500	
+106.20	22000	500	
+100.00	22000	500	
+95.00	22000	500	
+90.00	22000	500	
+85.00	22000	500	
+80.00	22000	500	
+75.60	22000	500	
+70.00	22000	500	
+65.00	22000	500	
+60.00	22000	500	
+55.00	22000	500	
+50.00	22000	500	
+45.00	22291	534	
+43.00	22408	548	
+40.00	22583	568	
+37.70	22717	584	
+31.95	23051	623	
+26.20	23386	662	
+23.00	23573	683	
+19.00	23806	711	
+14.00	24097	745	
+7.00	24505	792	
+5.00	24621	806	
+2.10	24790	826	
+0.00	24913	840	
-1.50	25000	850	



FOR TENDER PURPOSE ONLY

- NOTES: -
- ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
 - COMPLIANCE WITH STANDARDS SHALL RELATE TO LATEST PUBLISHED EDITIONS.
 - ALL ELEVATIONS ARE REFERRED TO THE FINISHED GROUND LEVEL OF POWER HOUSE BUILDING AS EL(±)0.00 M WHICH IS 2.90M FROM CHART DATUM AND CHART DATUM IS -0.64M FROM MEAN SEA LEVEL (MSL).
 - THE OTHER COMPONENTS OF THE CHIMNEY INCLUDE ROLL UP DOORS, PERSONNEL ACCESS DOORS, HAND RAILS, HOOD HATCH, LINER TEST PORTS, NON METALLIC EXPANSION JOINTS, RAIN WATER DRAINAGE SYSTEM, VENTILATION OPENINGS, ELECTRICAL POWER SUPPLY DISTRIBUTION BOARDS, LIGHTING PANELS, SOCKET OUTLETS, POWER AND CONTROL CABLING, RACEWAY SYSTEM, STAIR AND PLATFORM LIGHTING, LIGHTNING PROTECTION & GROUNDING SYSTEM, COMMUNICATIONS SYSTEM ETC. AND SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATIONS.
 - AIRCRAFT WARNING LIGHT (A.W.L.) SHALL BE PROVIDED TO MEET THE REQUIREMENT OF RELEVANT STANDARD STATUTORY BODY AND MEETING SPECIFICATIONS.



FOR TENDER PURPOSE ONLY

एनएलसी तमिलनाडु पावर लिमिटेड
NLC TAMILNADU POWER LIMITED

DEVELOPMENT CONSULTANTS PVT. LTD.

PROJECT: NTPCL-CONSTRUCTION OF ONE RCC ADDL. CHIMNEY OF 150 M HEIGHT WITH BOROSILICATE LINED BI-FLUE CAN ARRANGEMENT FOR FGD PLANT OF 2x500 MW COAL BASED TPP LOCATED AT TUTICORIN, TAMILNADU

STATUS: CONTRACT

DISTRIBUTION: PRINT SCALE IN METRE 0 10 20 30 40 50

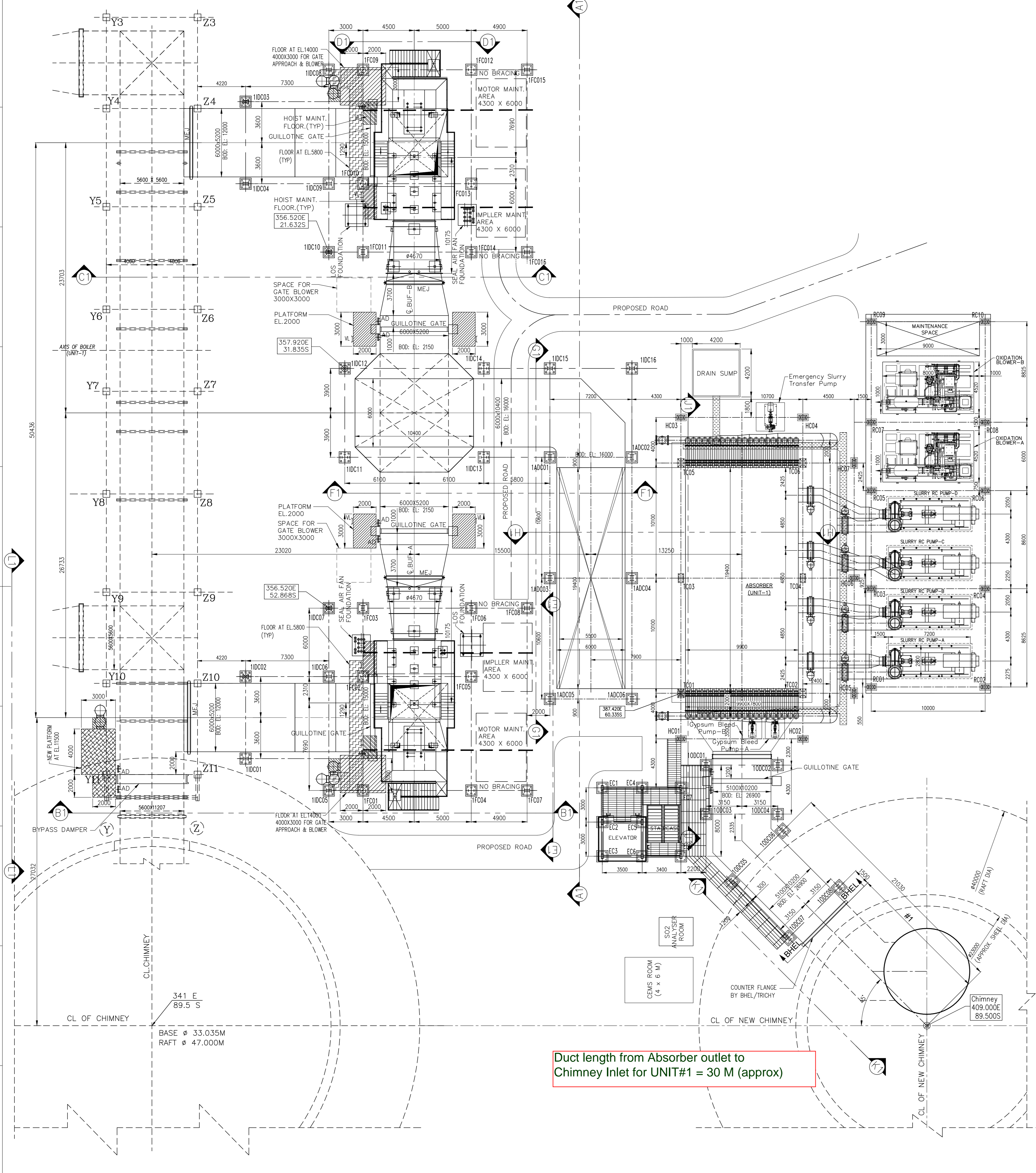
DATE: 02.02.2022

PROJECT ENGINEERING MANAGEMENT Noida (I.P.)

FGD CHIMNEY
INPUT FOR WET STACK STUDY
DRAWING NO.

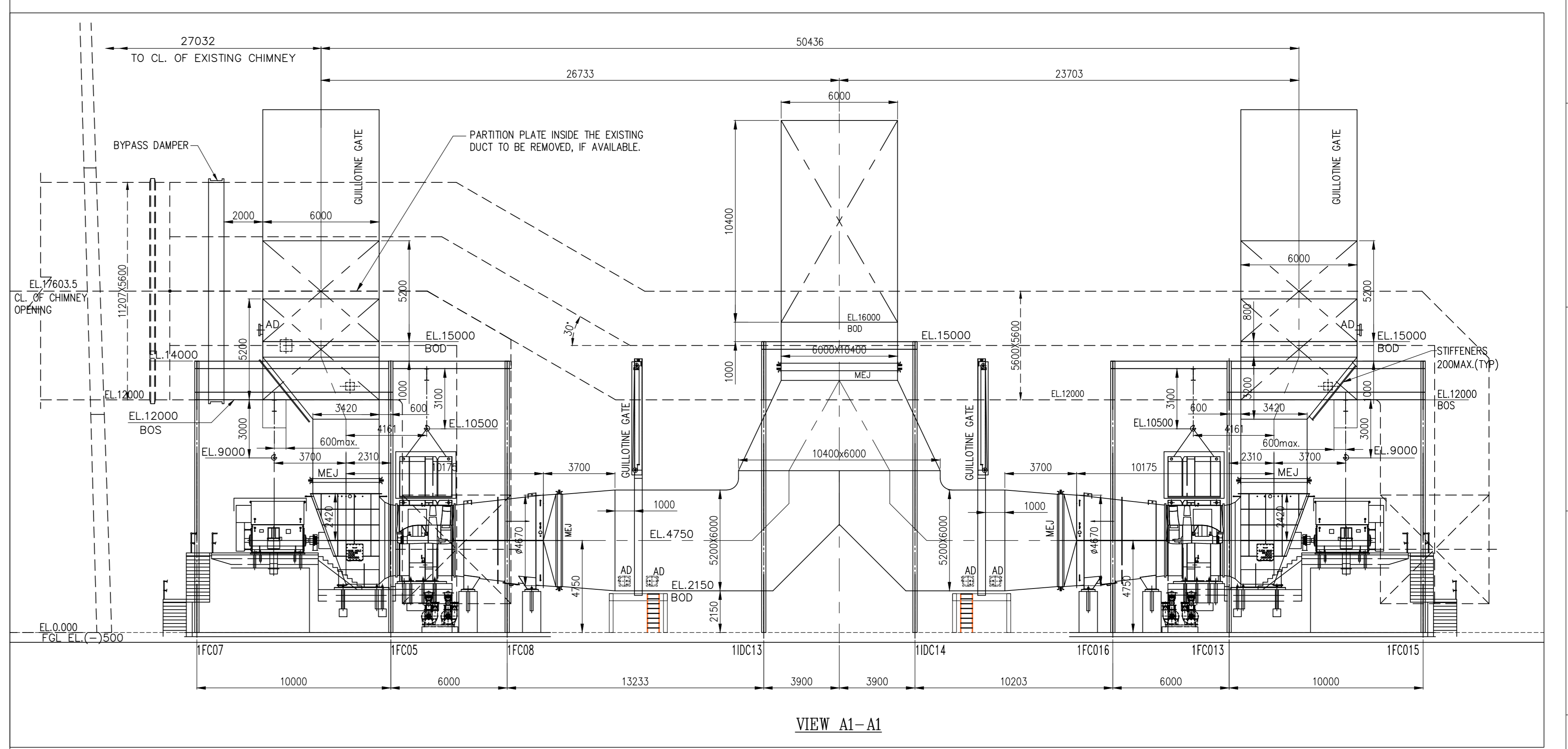
SHEET 1 OF 1

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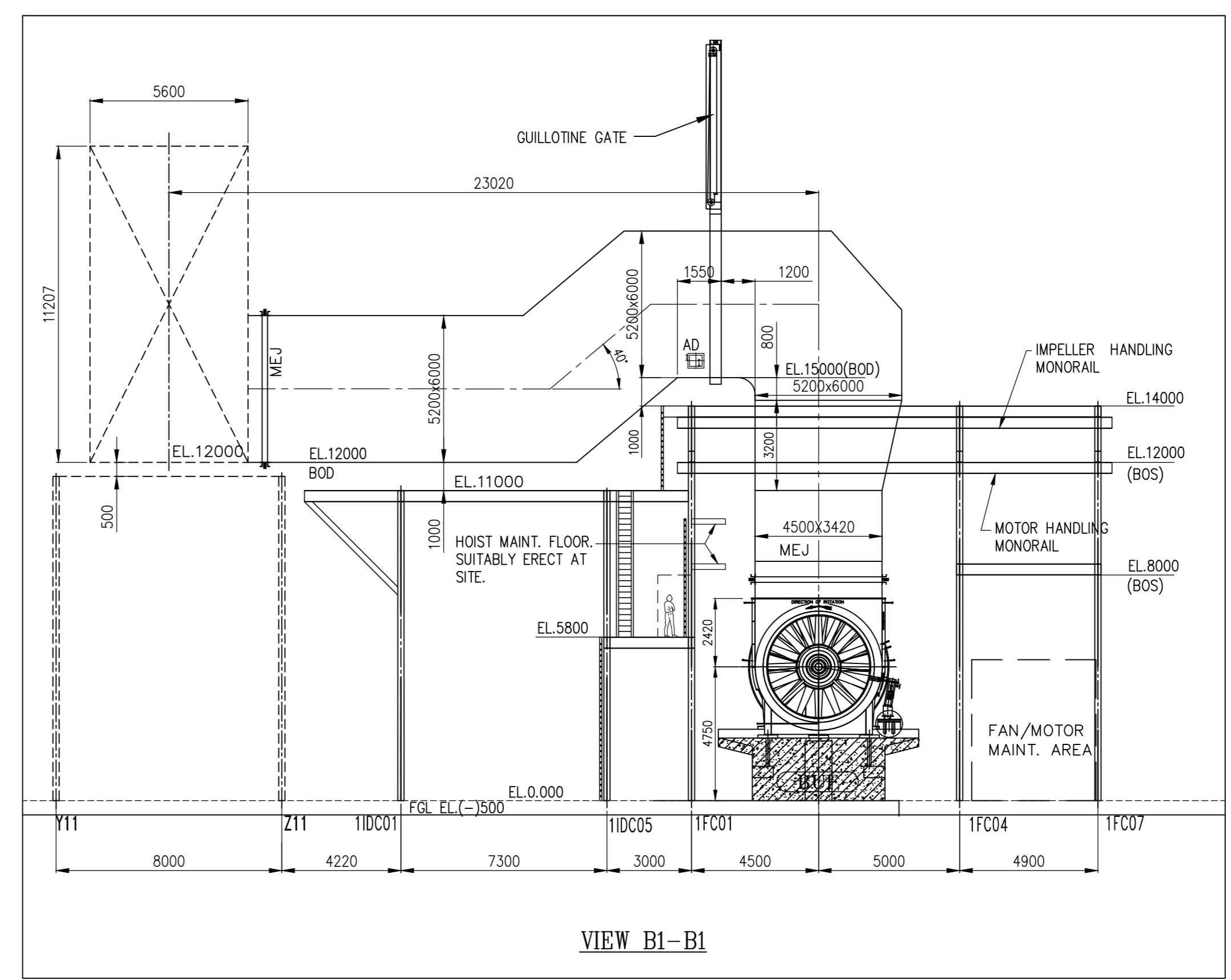


UNIT-1 PLAN

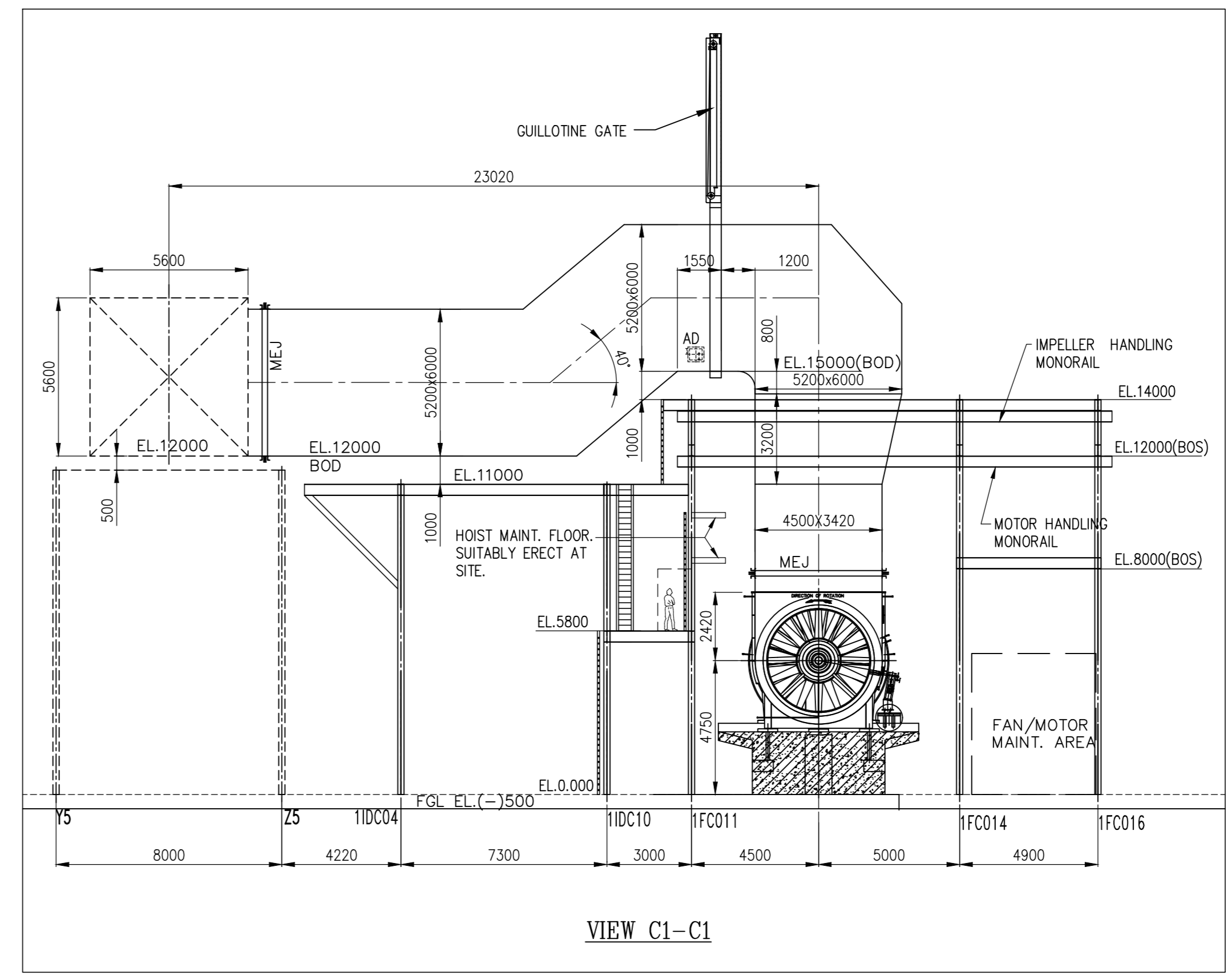
Duct length from Absorber outlet to Chimney Inlet for UNIT#1 = 30 M (approx)



VIEW A1-A1



VIEW B1-B1



VIEW C1-C1

LEGENDS-
 FGL - FINISHED GROUND LEVEL
 NMEJ - NON METALLIC EXPANSION JOINT
 MEJ - METALLIC EXPANSION JOINT

REF. DRAWINGS-
 1.FGD PLAN LAYOUT - PY-DG-0-M162-1252-01

NOTES-
 1. ALL DIMENSIONS ARE IN MM.
 2. EL(+)-0.00 CORRESPONDS TO FINISH FLOOR LEVEL OF PLANT WHICH IS 2.90 M FROM CHART DATUM AND CHART DATUM IS (-)0.64M FROM MSL.
 3. DIMENSION 'Ø1' WILL BE PROVIDED AFTER GETTING THE ACTUAL SHELL DIA OF NEW CHIMNEY.

CUSTOMER NOS: G515 & G516

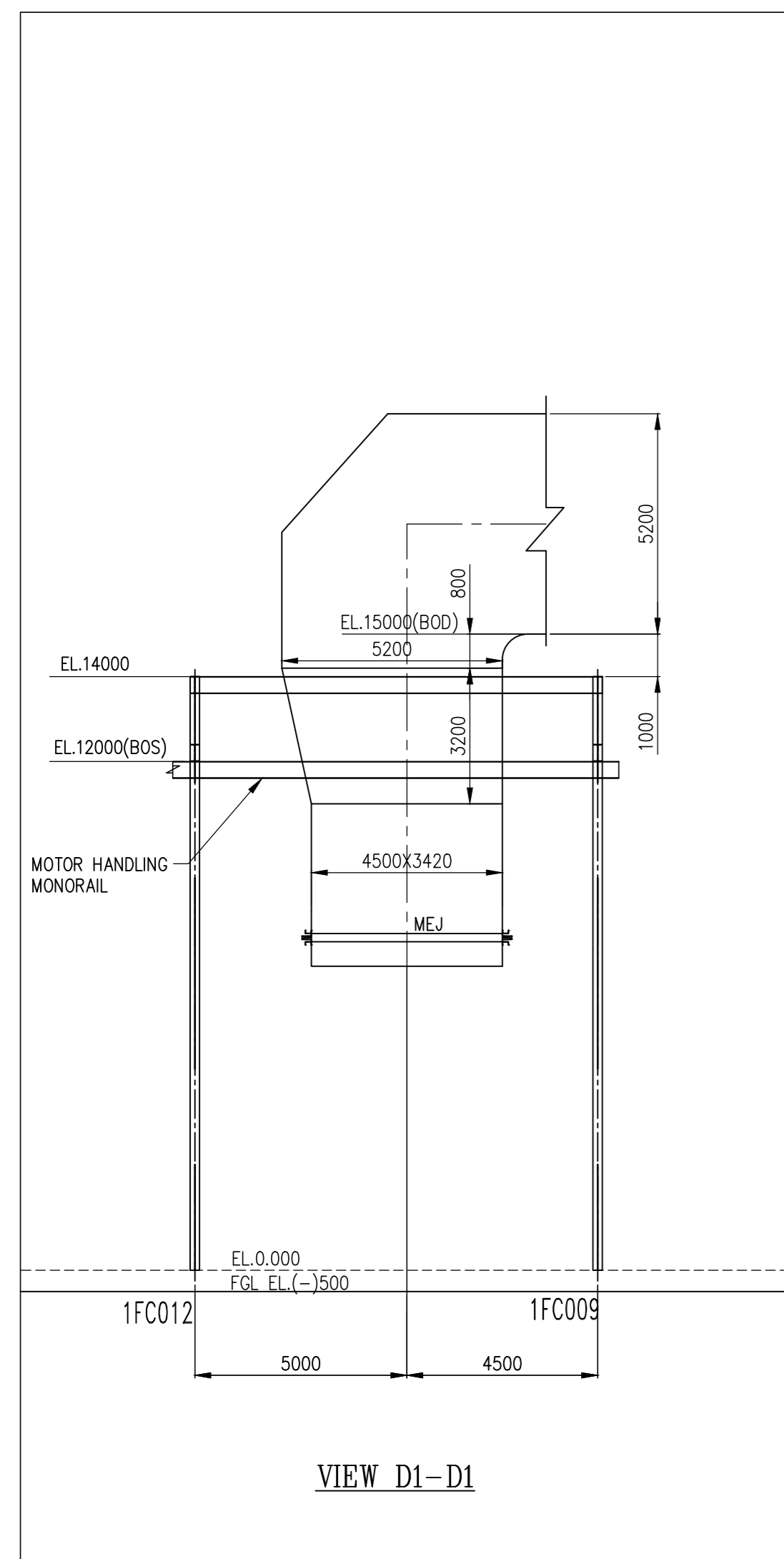
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 CUSTOMER: NLC TAMILNADU POWER LTD.
 PROJECT: TUTICORIN 2X500MW FGD PACKAGE

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CHK	BS		22-12-2020
APPR	KK		22-12-2020

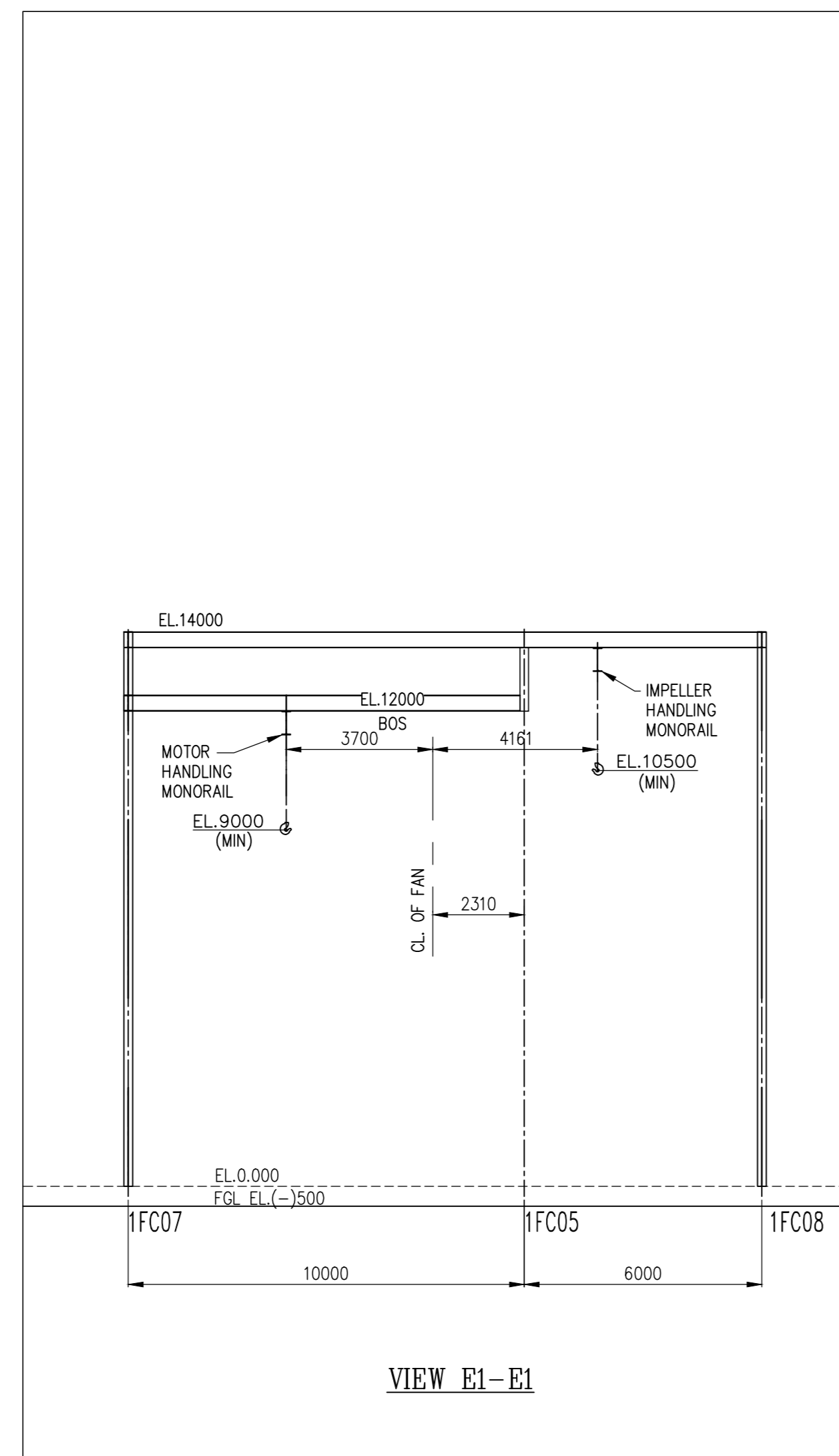
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 DRAWING NO. 3-FW-000-01638 SH-01/04 REV:03

REV	DATE	ALTERED	CHECKED	APPROVED	REVISION	REMARKS
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02	20.02.21	NKS	BS	KK		
01	01.02.21	NKS	BS	KK		

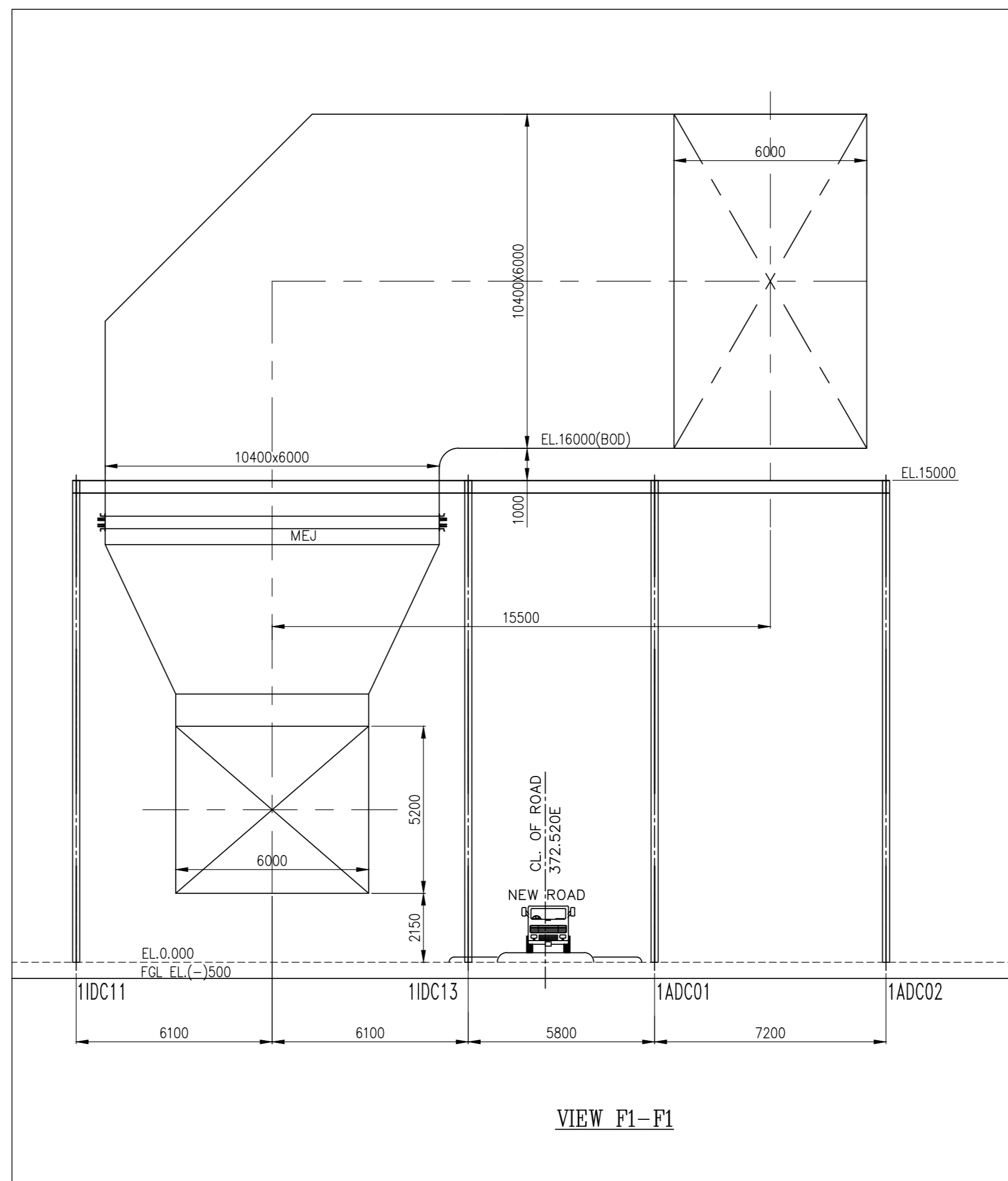
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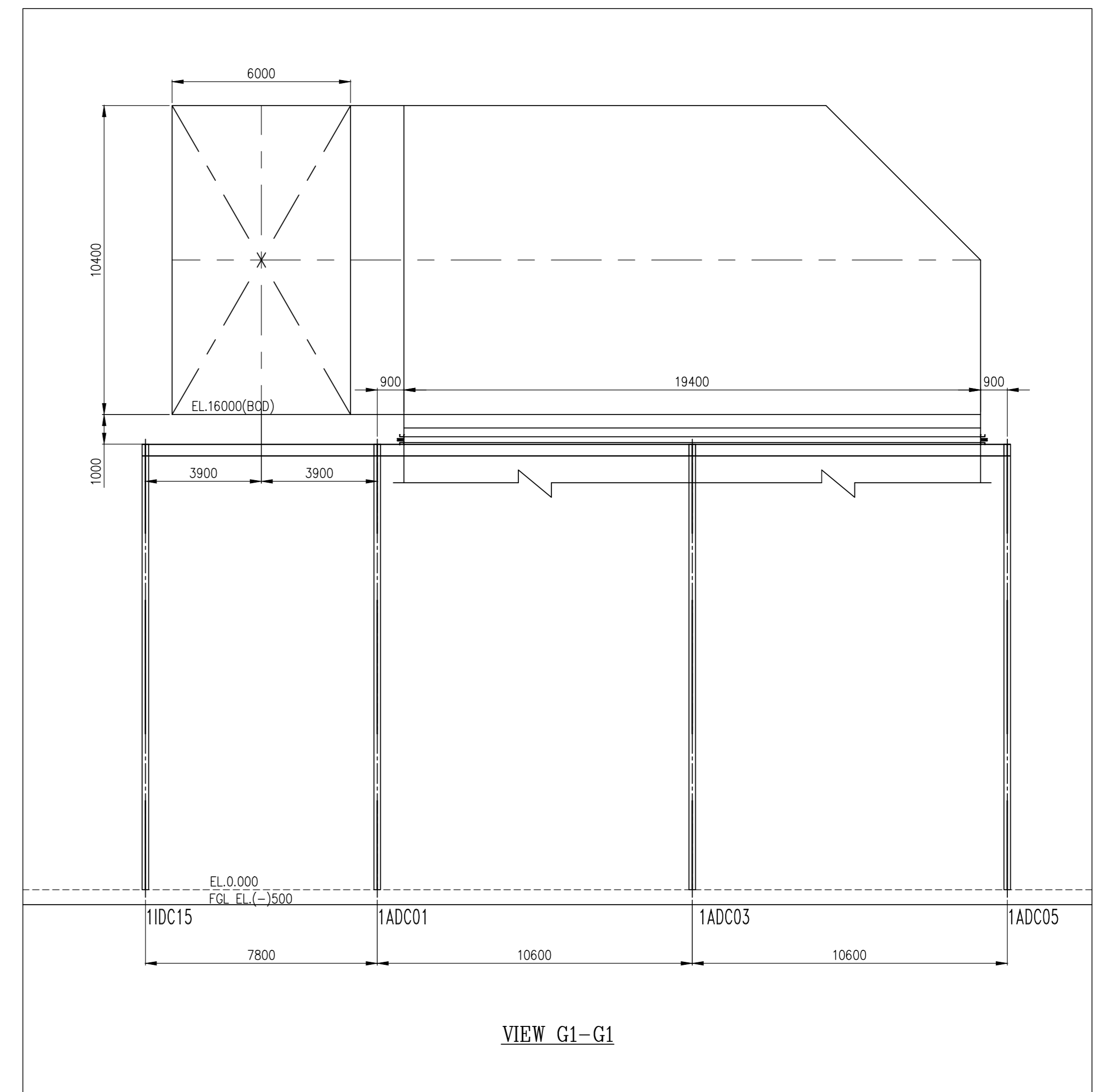
VIEW D1-D1



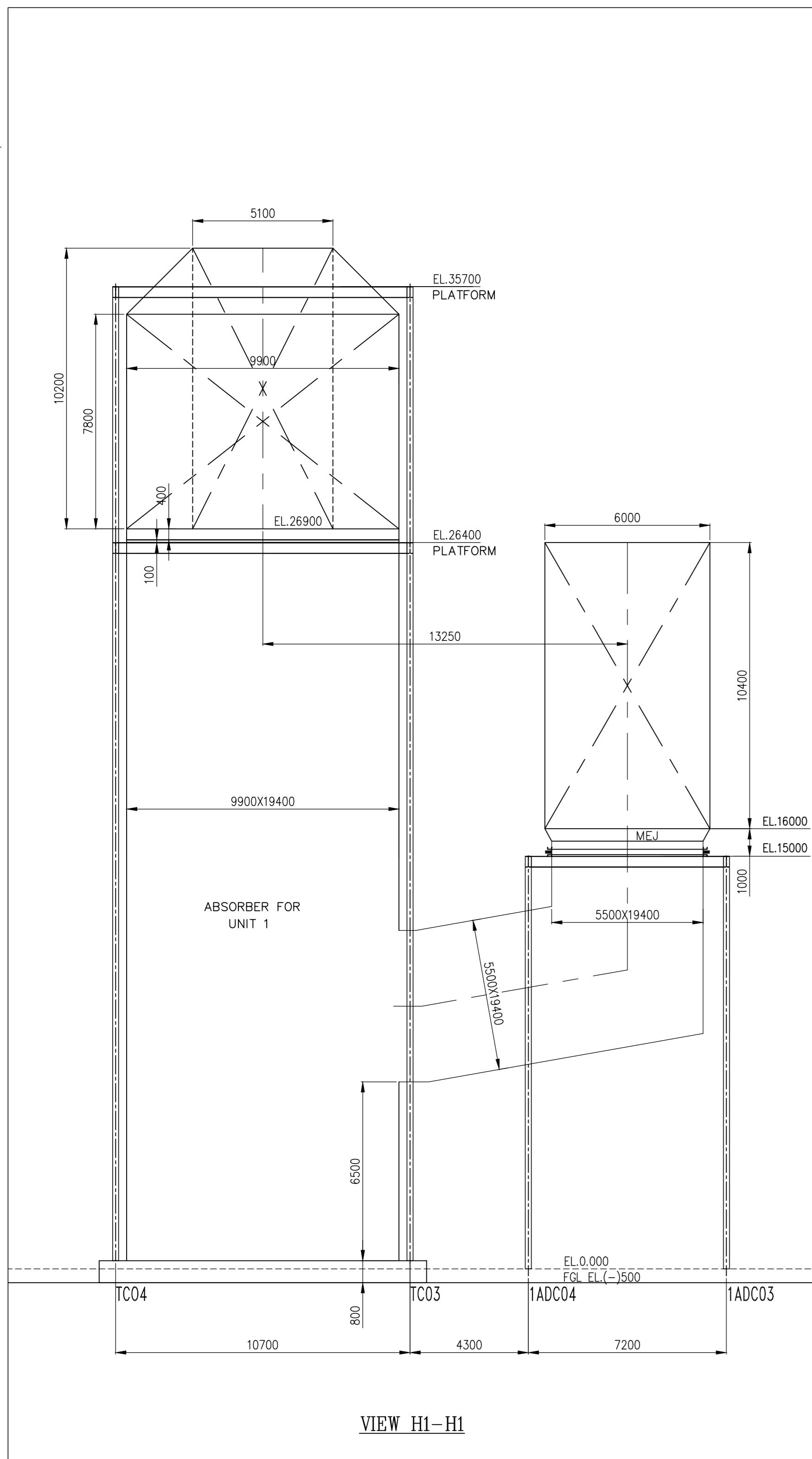
VIEW E1-E1



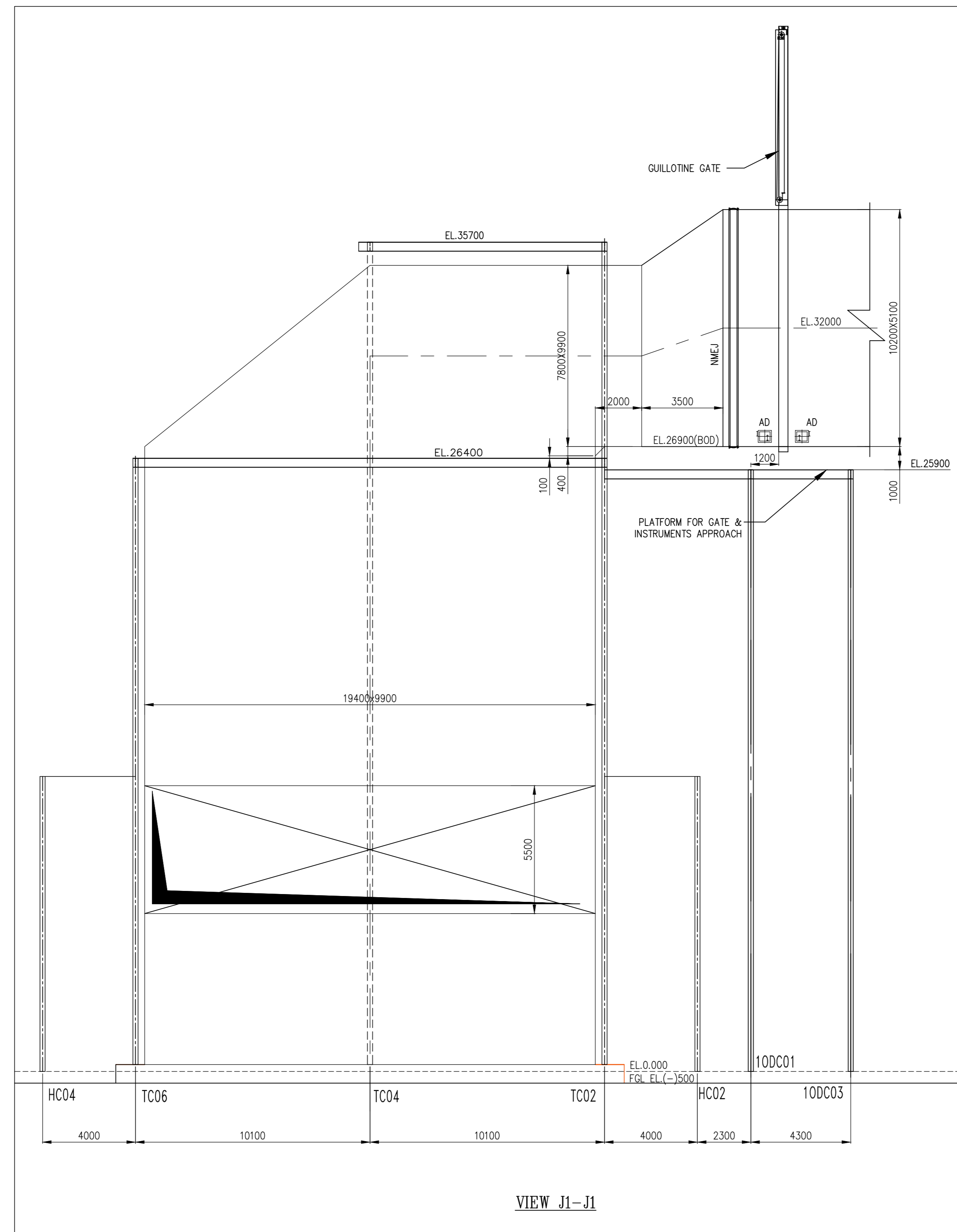
VIEW F1-F1



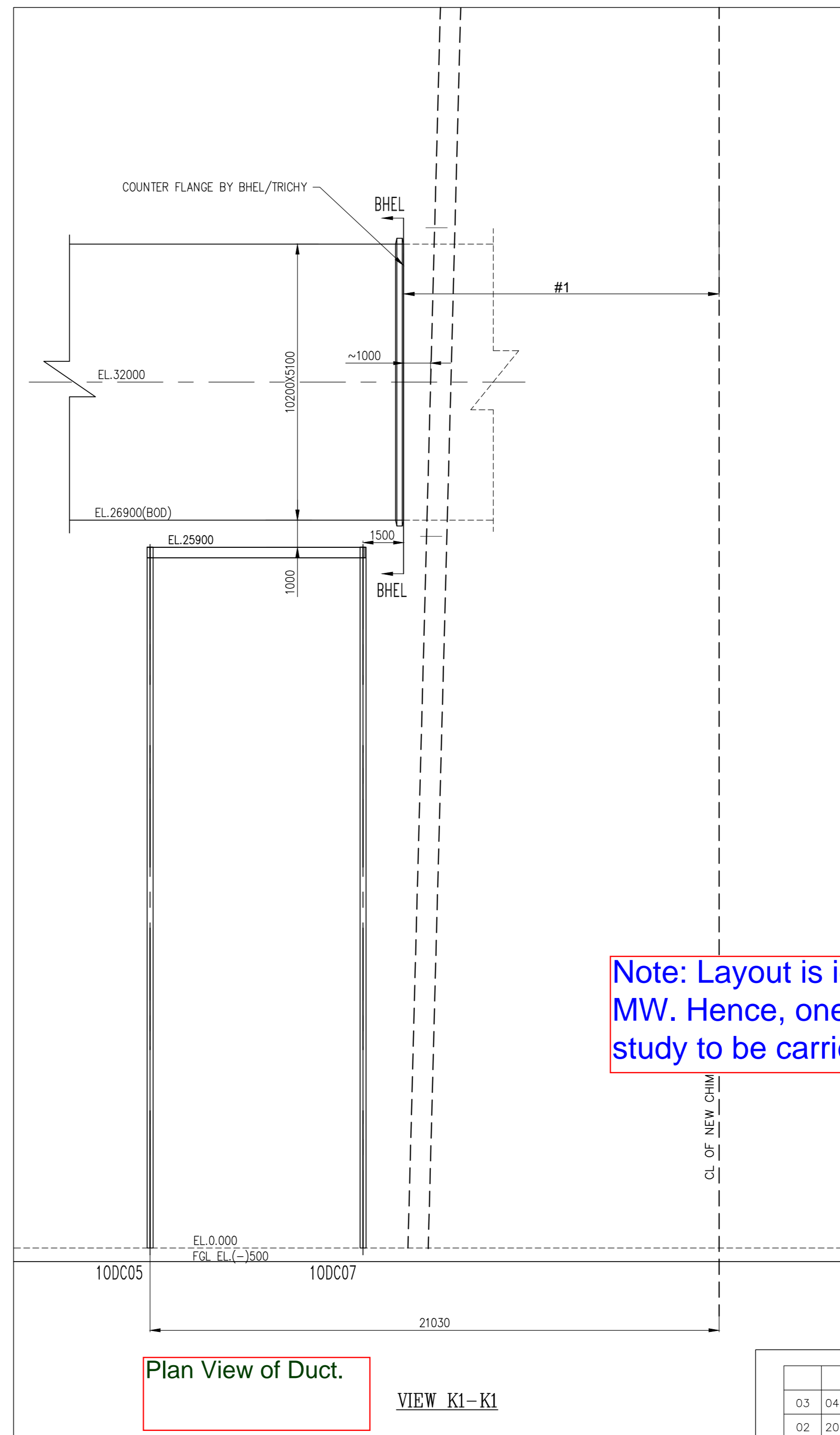
VIEW G1-G1



VIEW H1-H1

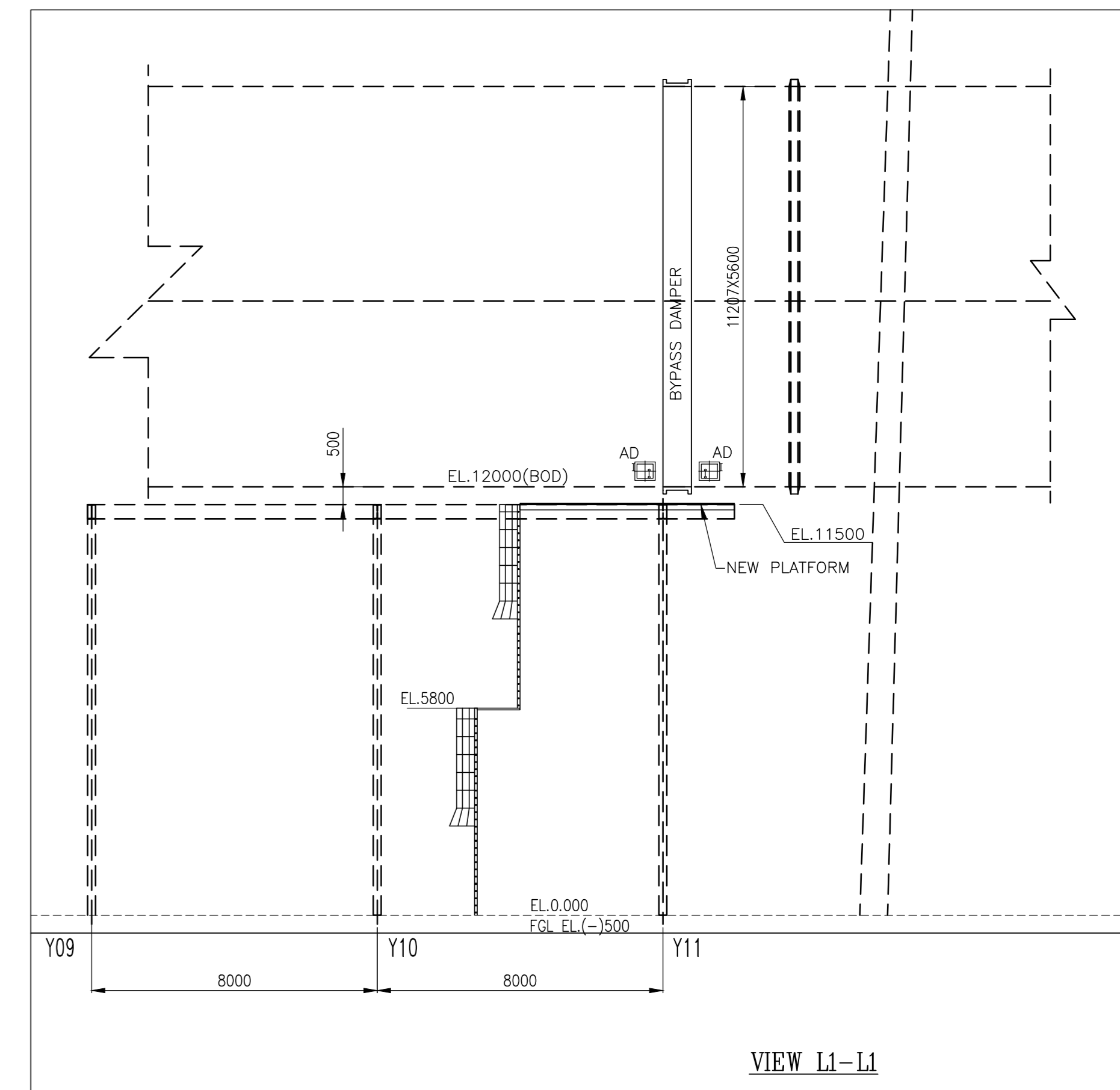


VIEW J1-J1



Plan View of Duct.

VIEW K1-K1



VIEW L1-L1

Note: Layout is identical for both two 500 MW. Hence, one no.(01) condensate flow study to be carried out.

- LEGENDS-**
 FGL - FINISHED GROUND LEVEL
 NMEJ - NON METALLIC EXPANSION JOINT
 MEJ - METALLIC EXPANSION JOINT
- REF. DRAWINGS-**
 1.FGD PLAN LAYOUT - PY-DG-0-M162-1252-01
- NOTES-**
 1. ALL DIMENSIONS ARE IN MM.
 2. EL(±) 0.00 CORRESPONDS TO FINISH FLOOR LEVEL OF PLANT WHICH IS 2.90 M FROM CHART DATUM AND CHART DATUM IS (-)0.64M FROM MSL.
 3. DIMENSION "H" WILL BE PROVIDED AFTER GETTING THE ACTUAL SHELL DIA OF NEW CHIMNEY.

CUSTOMER NOS: G515 & G516

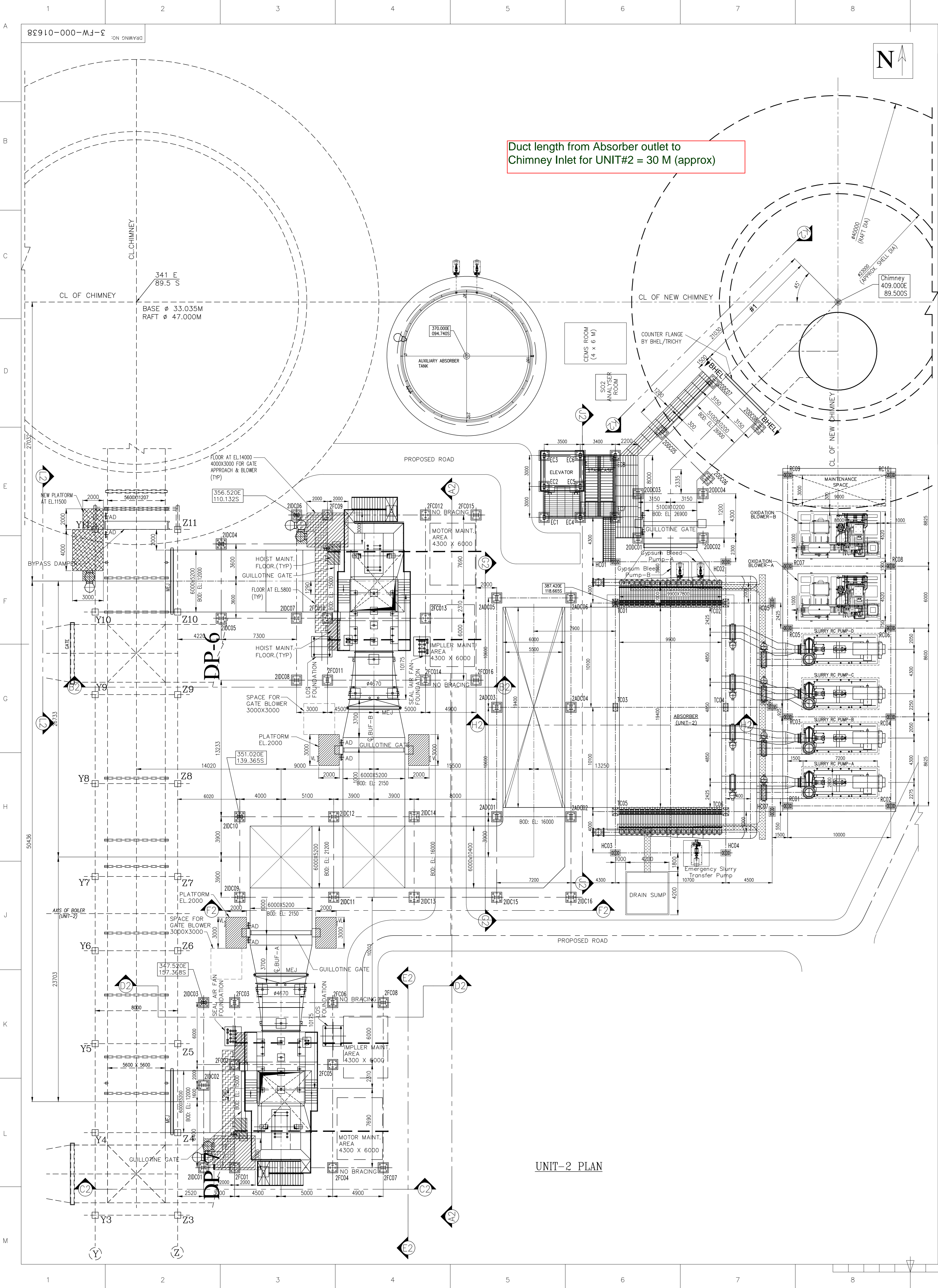
NTPL DRAWING NO :
 CUSTOMER: NLC TAMILNADU POWER LTD.
 PROJECT: TUTICORIN 2X500MW FGD PACKAGE

REV	DATE	ALTERED	CHECKED	APPROVED	REVISION	REMARKS
03	04.06.21	SXR	SXR	KAP	DRG. UPDATED.	
02	20.02.21	NKS	BS	KK		
01	01.02.21	NKS	BS	KK		

DEPT: BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RAIPUR-436. APPD: KK

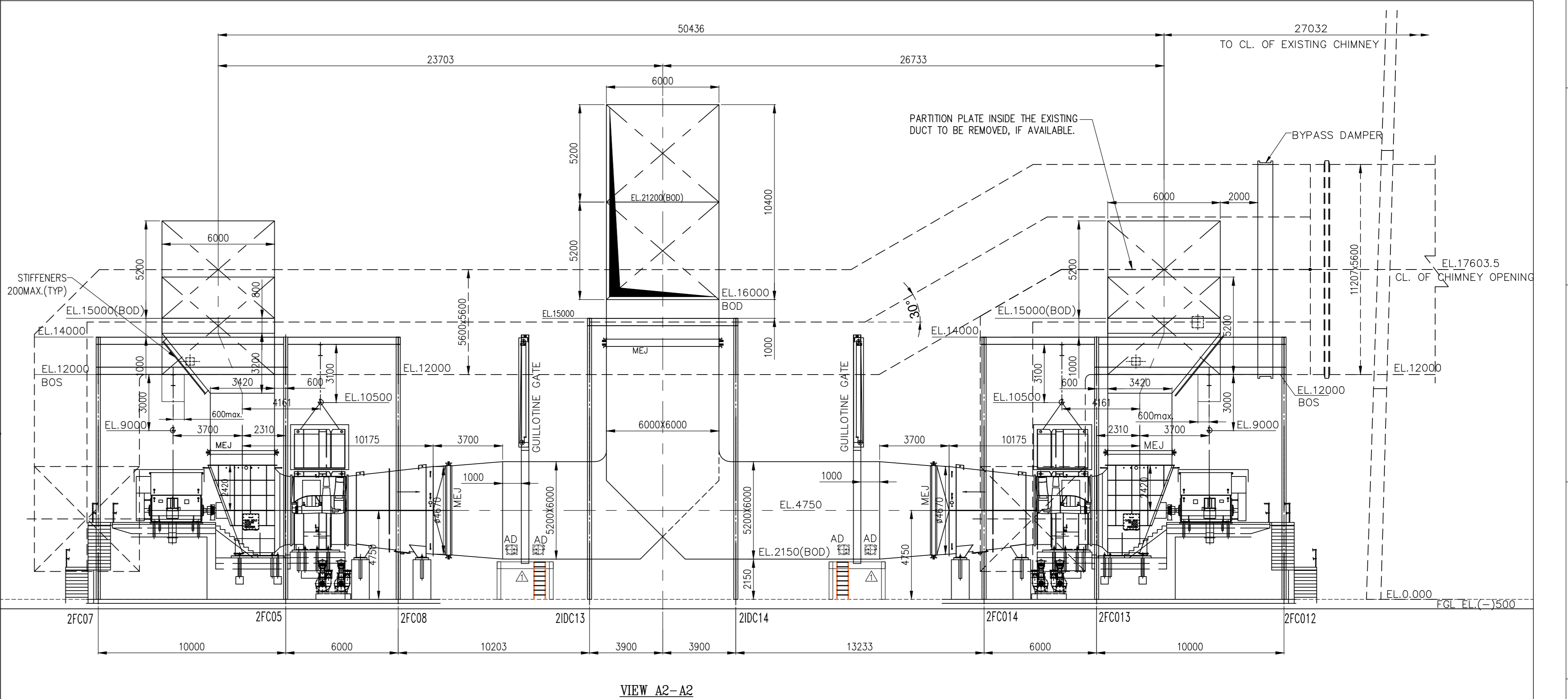
TITLE: GA OF DUCTING (UNIT-1) (SECTIONS) SCALE: 1:125

DRAWING NO. 3-FW-000-01638 SH-02/04 REV:03

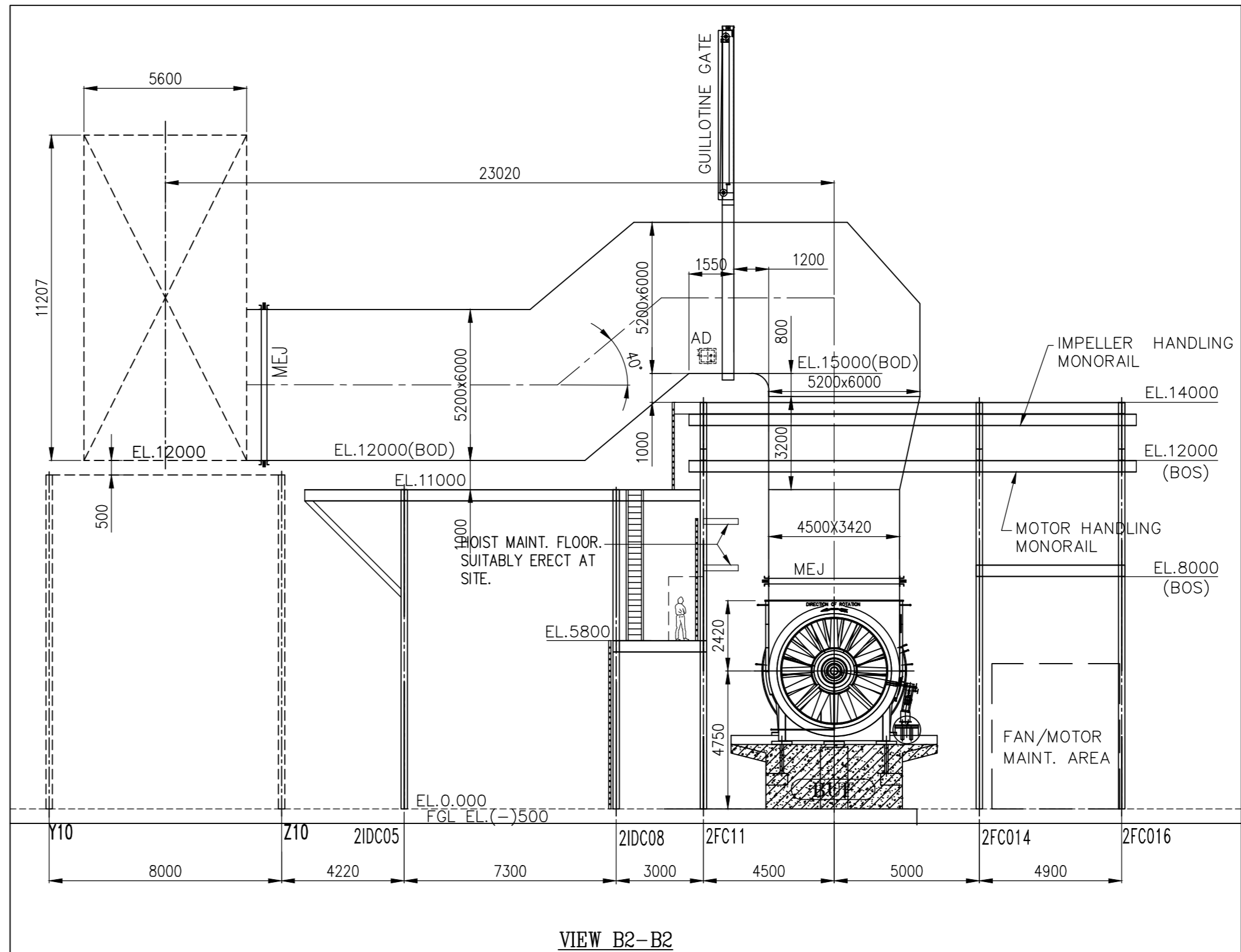


Duct length from Absorber outlet to Chimney Inlet for UNIT#2 = 30 M (approx)

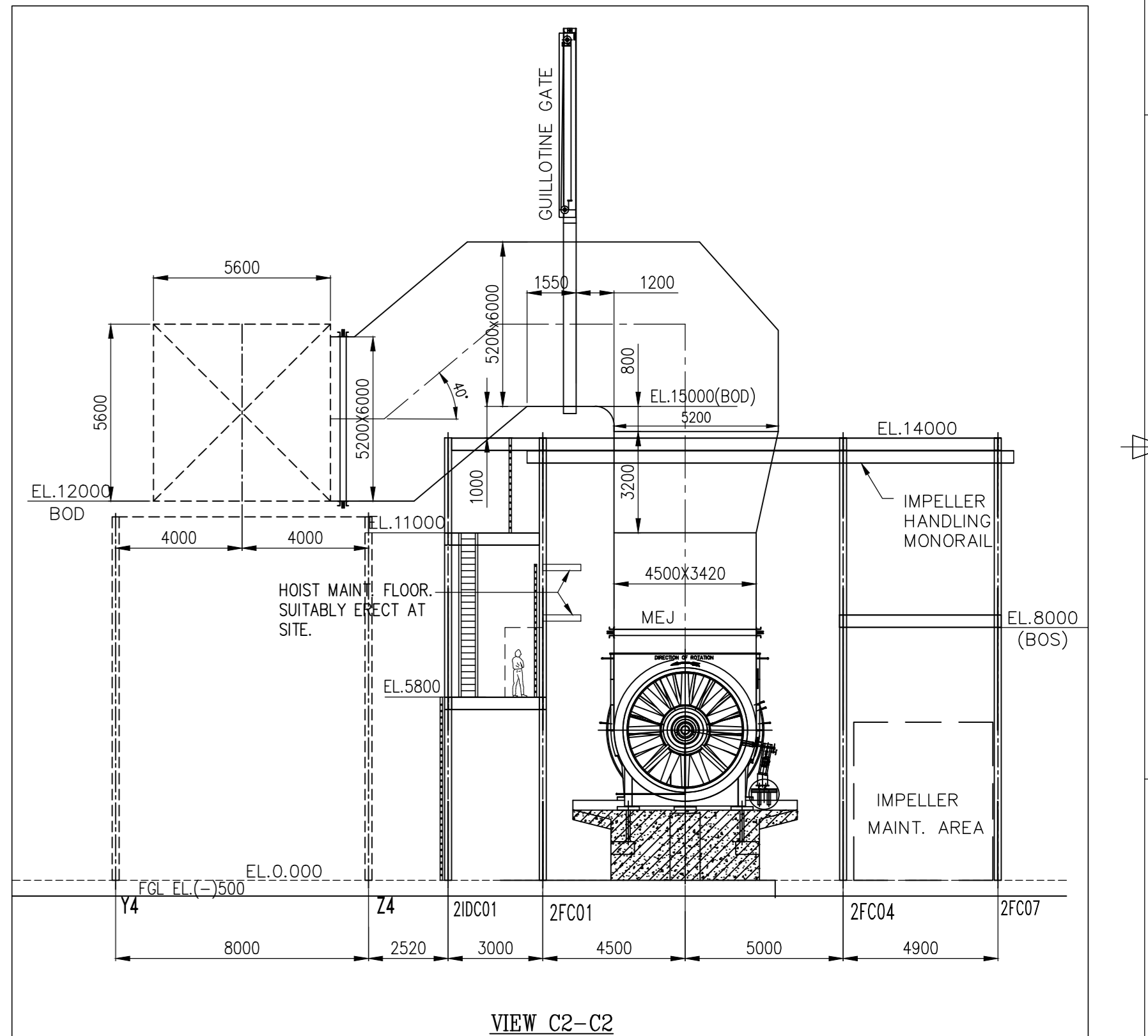
UNIT-2 PLAN



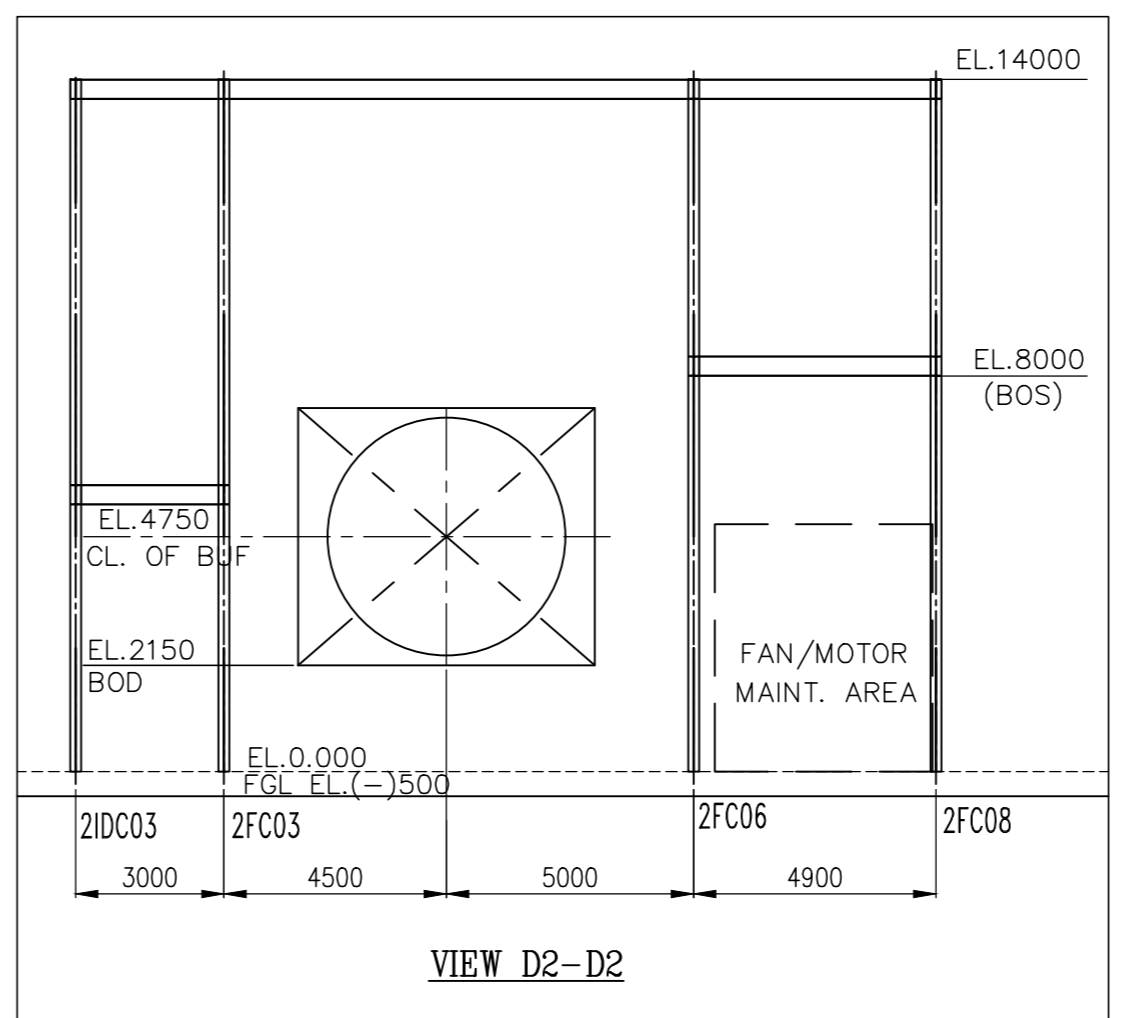
VIEW A2-A2



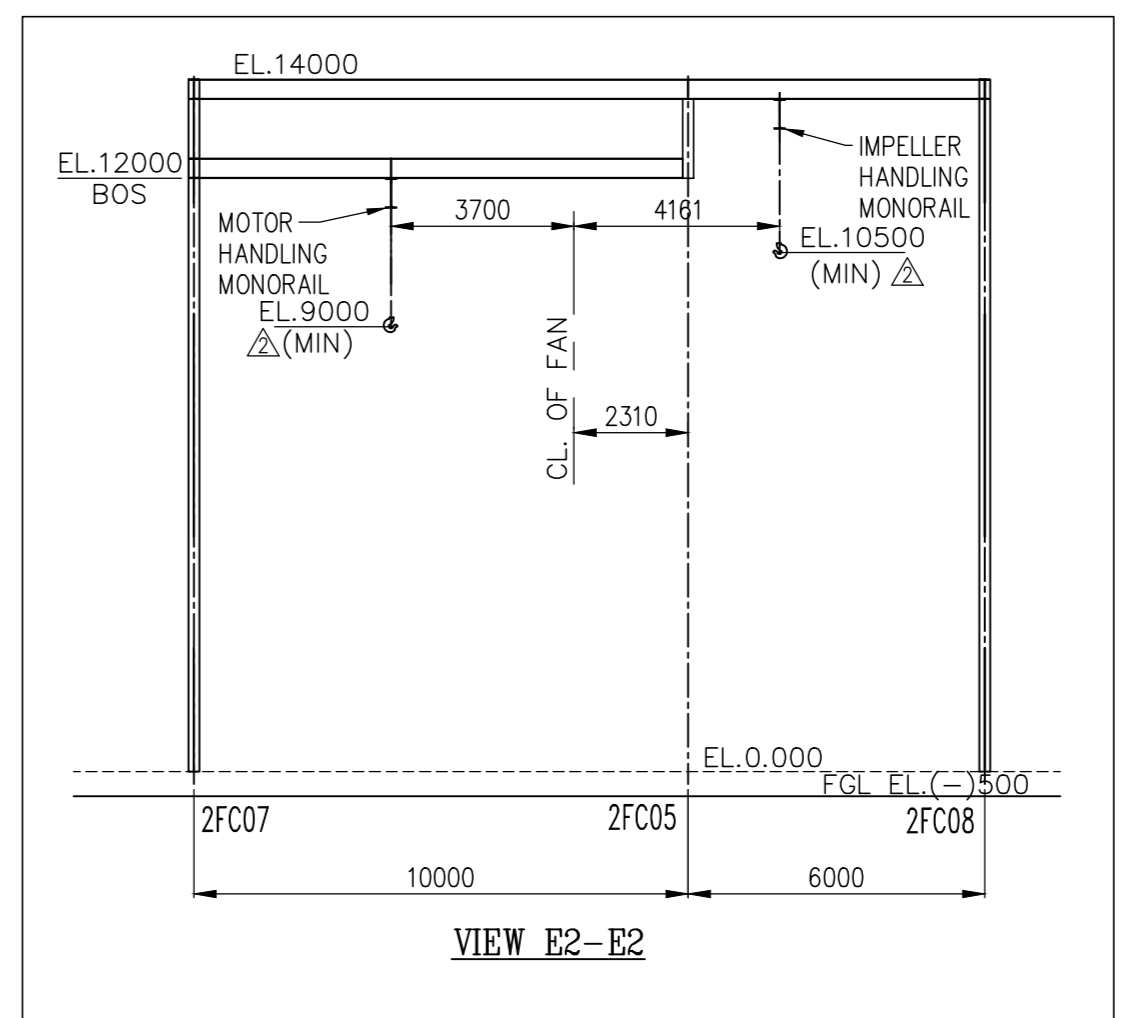
VIEW B2-B2



VIEW C2-C2



VIEW D2-D2



VIEW E2-E2

- LEGENDS-**
 FGL - FINISHED GROUND LEVEL
 NMEJ - NON METALLIC EXPANSION JOINT
 MEJ - METALLIC EXPANSION JOINT
- REF. DRAWINGS-**
 1.FGD PLAN LAYOUT - PY-DG-0-M162-1252-01
- NOTES-**
 1. ALL DIMENSIONS ARE IN MM.
 2. EL(+).0.00 CORRESPONDS TO FINISH FLOOR LEVEL OF PLANT WHICH IS 2.90 M FROM CHART DATUM AND CHART DATUM IS (-)0.64M FROM MSL.
 3. DIMENSION 'R1' WILL BE PROVIDED AFTER GETTING THE ACTUAL SHELL DIA OF NEW CHIMNEY.

CUSTOMER NOS: G515 & G516

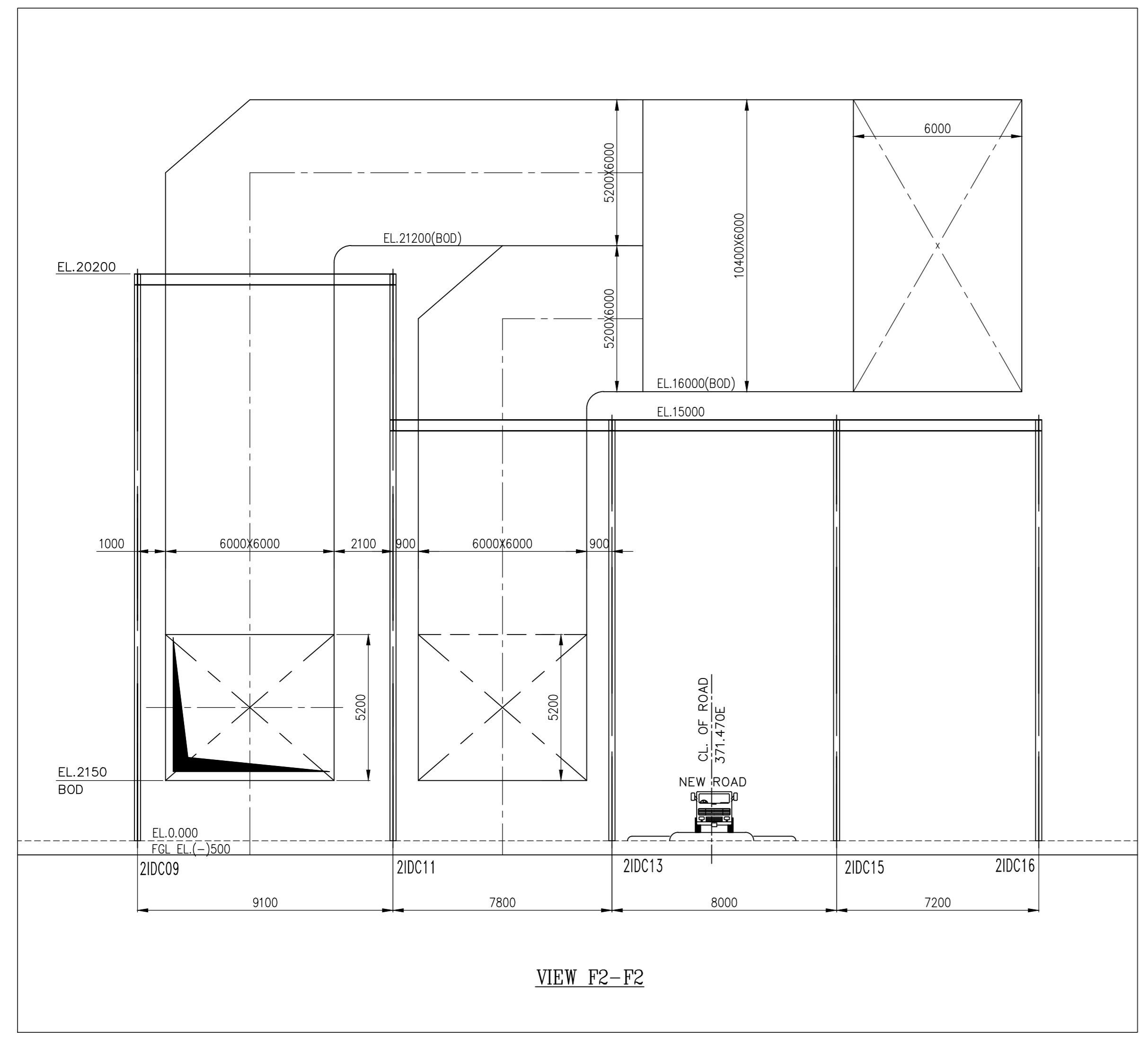
NTPD DRAWING NO :
 CUSTOMER: NLC TAMILNADU POWER LTD.
 PROJECT: TUTICORIN 2X500MW FGD PACKAGE

DEPT	NAME	SNR	DATE
CHD	NKS	++	02-13-2020
BS	BS	++	02-13-2020
APPD	KK	++	02-13-2020

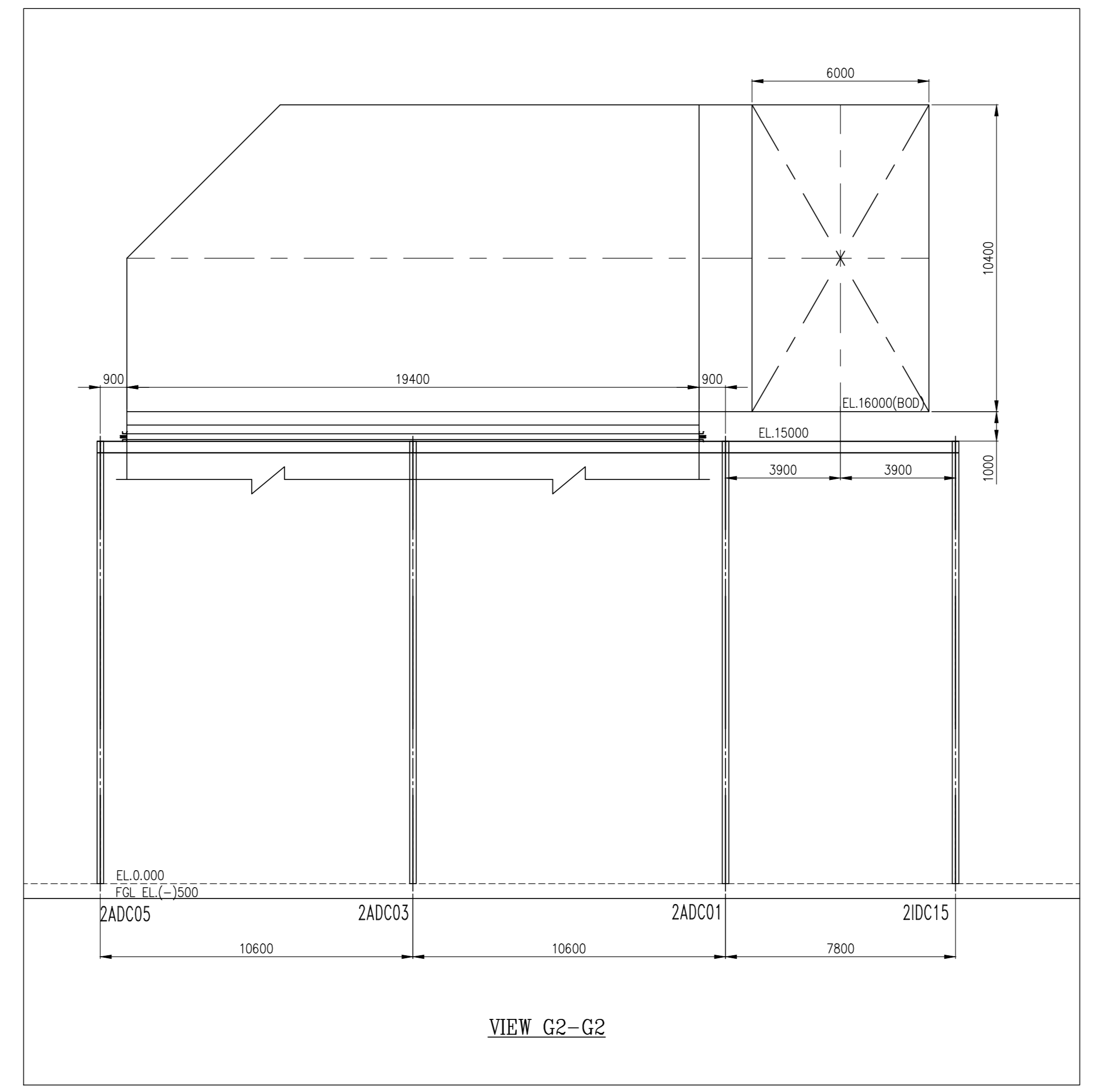
TITLE: GA OF DUCTING (UNIT-2) (PLAN & ELEVATIONS) SCALE: 1:150

DRAWING NO. 3-FW-000-01638 SH-03/04 REV:03

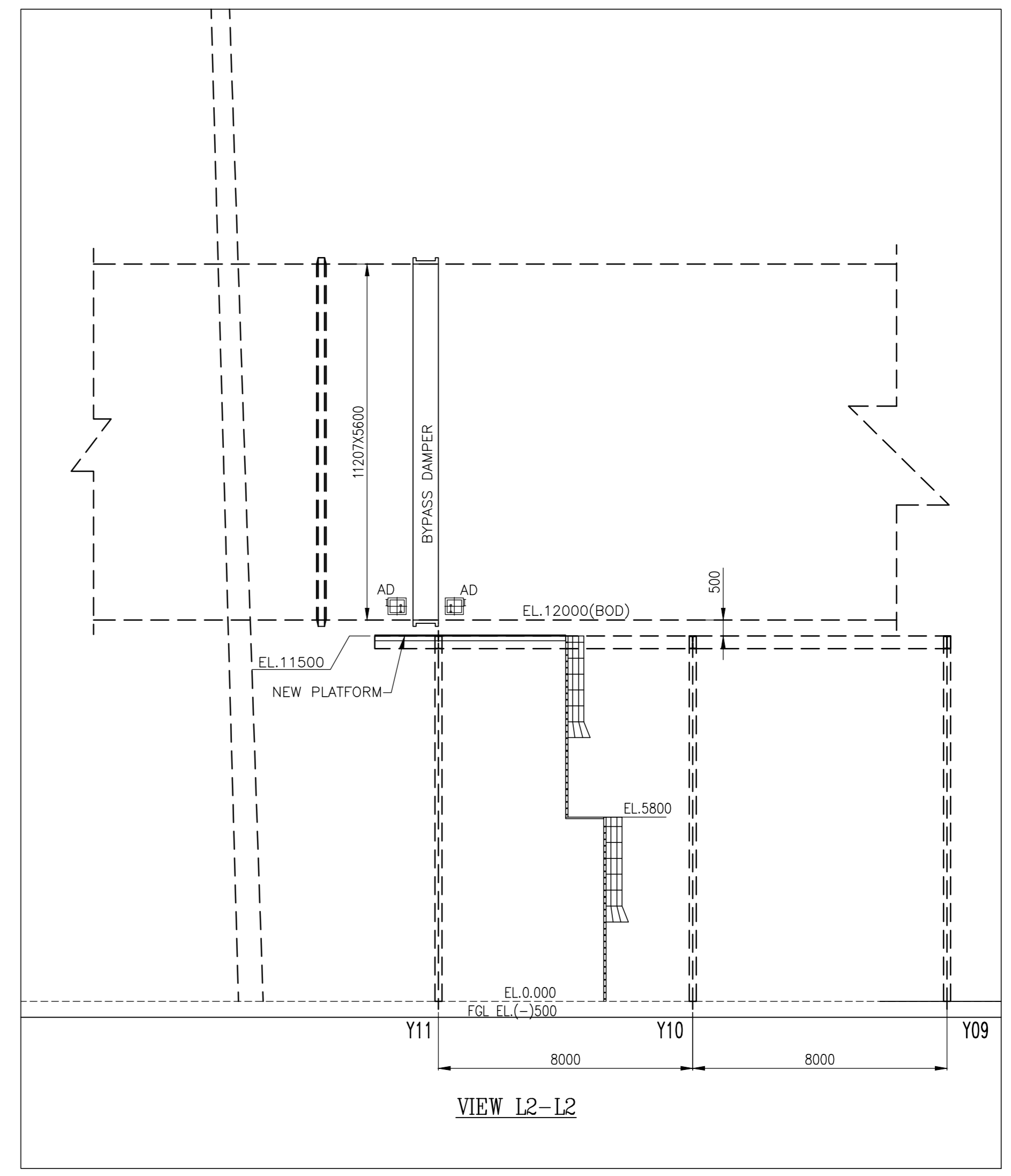
REV	DATE	ALTERED	CHECKED	APPROVED	REVISION	REMARKS
03	04.06.21	SXR	SXR	KAP	DRG. UPDATED.	
02	20.02.21	NKS	BS	KK		
01	01.02.21	NKS	BS	KK		



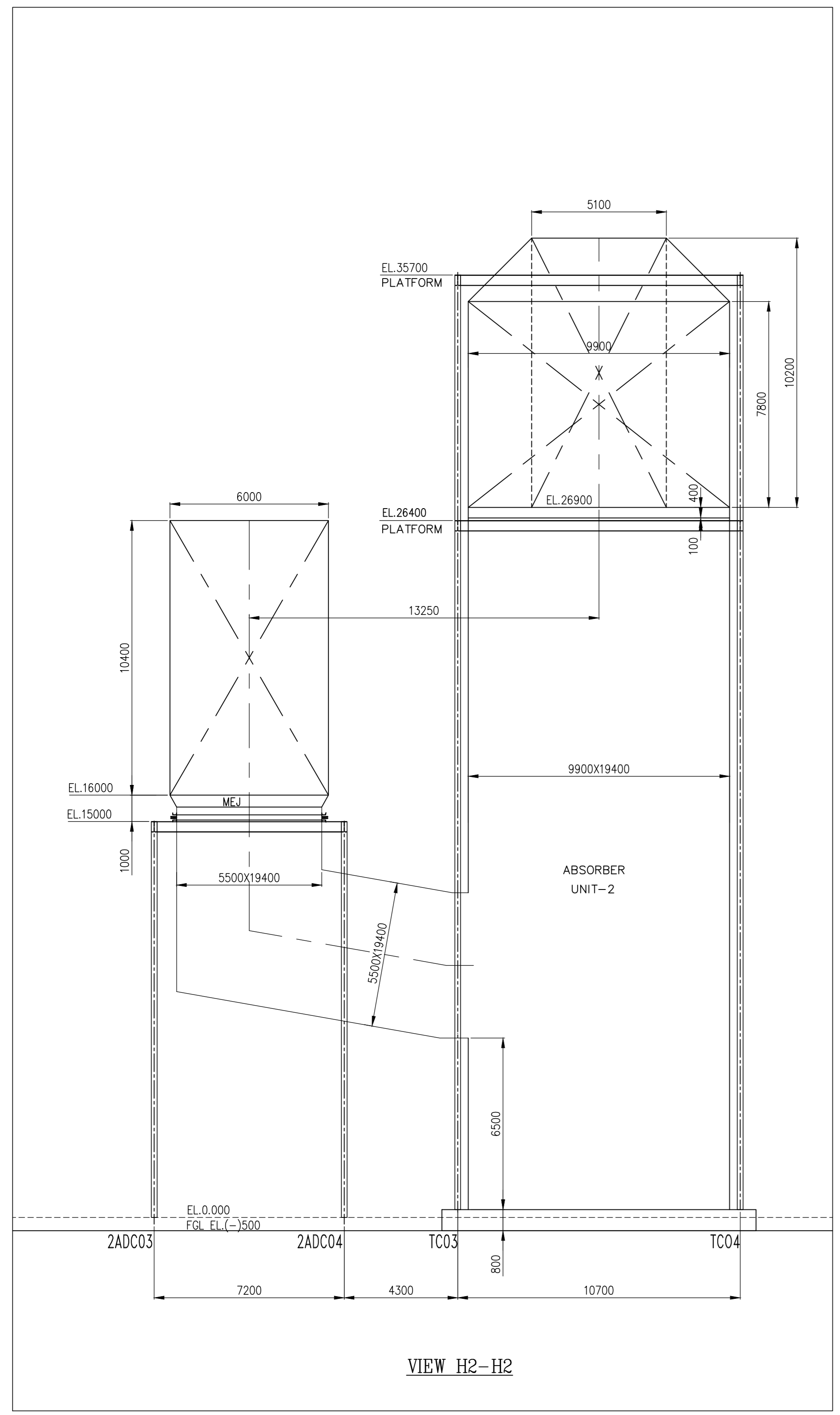
VIEW F2-F2



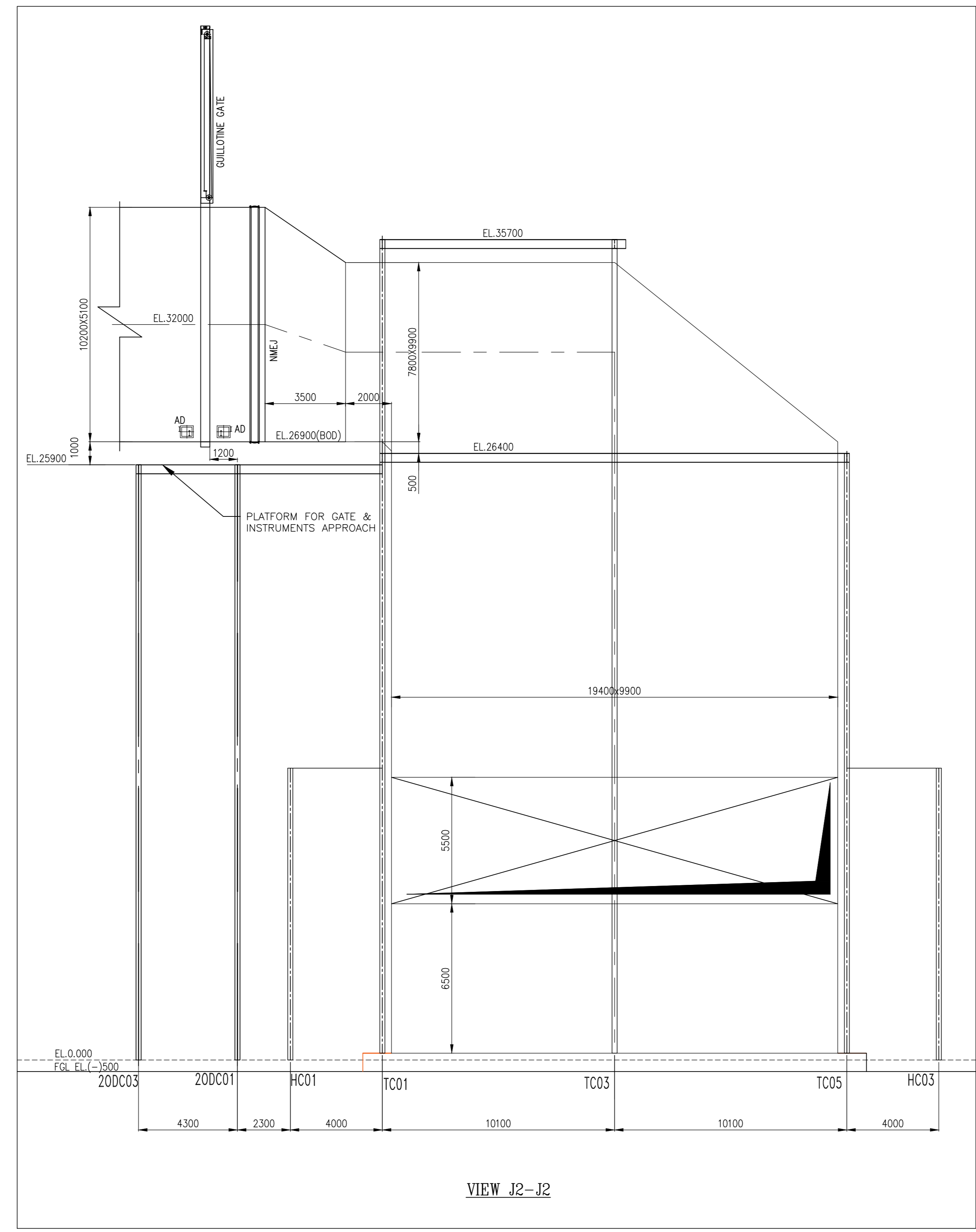
VIEW G2-G2



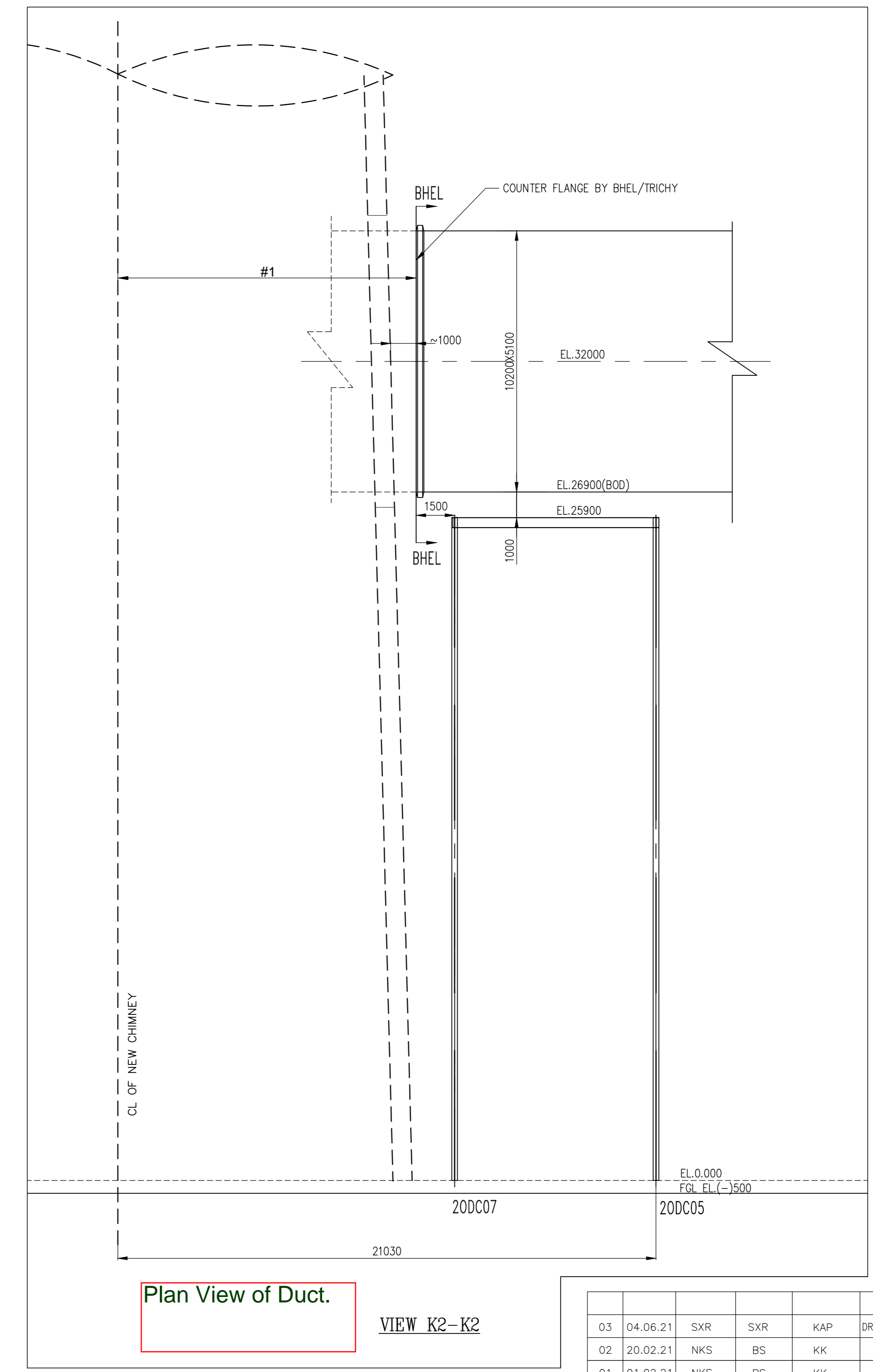
VIEW I2-I2



VIEW H2-H2



VIEW J2-J2



Plan View of Duct.

VIEW K2-K2

Note: Layout is identical for both two 500 MW. Hence, one no.(01) condensate flow study to be carried out.

- LEGENDS-**
 FGL - FINISHED GROUND LEVEL
 NMEJ - NON METALLIC EXPANSION JOINT
 MEJ - METALLIC EXPANSION JOINT
- REF. DRAWINGS-**
 1.FGD PLAN LAYOUT - PY-DG-0-M162-1252-01
- NOTES-**
 1. ALL DIMENSIONS ARE IN MM.
 2. EL(±) 0.00 CORRESPONDS TO FINISH FLOOR LEVEL OF PLANT WHICH IS 2.90 M FROM CHART DATUM AND CHART DATUM IS (-)0.64M FROM MSL.
 3. DIMENSION "H" WILL BE PROVIDED AFTER GETTING THE ACTUAL SHELL DIA OF NEW CHIMNEY.

CUSTOMER NOS: G515 & G516

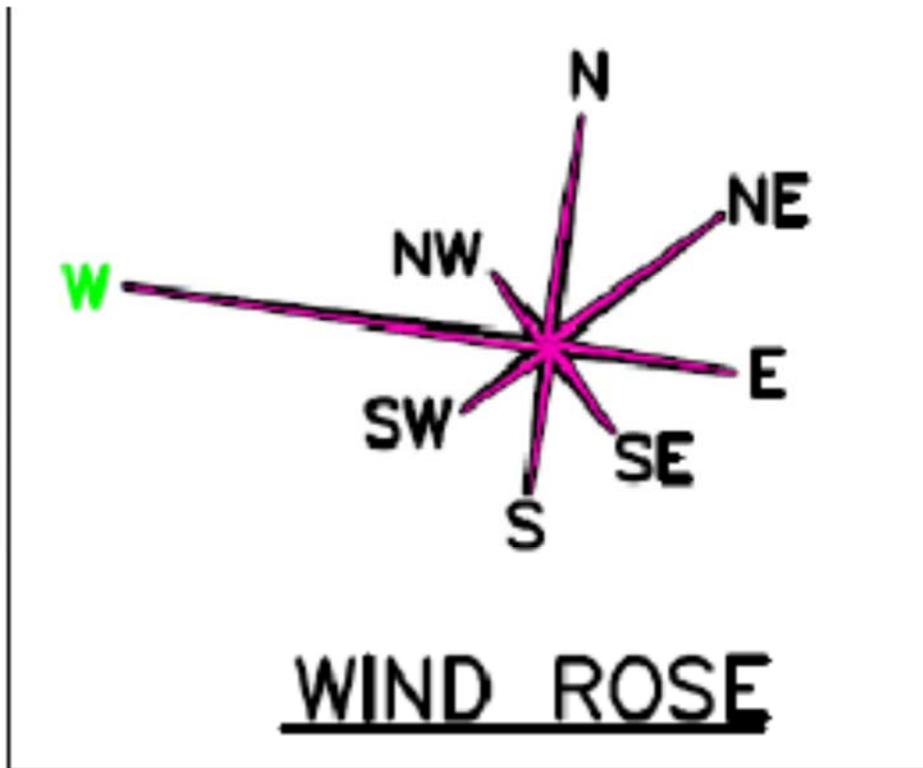
NTPCL DRAWING NO :

CUSTOMER: NLC TAMILNADU POWER LTD.
 PROJECT: TUTICORIN 2X500MW FGD PACKAGE

REV	DATE	ALTERED	CHECKED	APPROVED	REVISION	REMARKS
03	04.06.21	SXR	SXR	KAP	DRG. UPDATED.	
02	20.02.21	NKS	BS	KK		
01	01.02.21	NKS	BS	KK		

DRAWING NO. 3-FW-000-01638 SH-04/04 REV:03

SCALE: 1:125



SECTION-7

TERMS AND CONDITIONS OF DEPUTATION OF EXPERTS/ SPECIALISTS

7. Terms & Conditions of Deputation of Foreign Experts/ Specialists

This concerns the terms & conditions of deputation of foreign Experts/Specialists for supervision of manufacture, erection, commissioning & performance guarantee tests and till end of warranty period.

7.1 Deputation of Experts

The Contractor shall depute requisite number of Experts/Specialists to India to fulfill its obligations under the Contract and in particular ensuring that the work is completed as per time schedule. The man-months of such Experts/Specialist to be deputed to India by the Contractor shall not be less than those as stipulated in Annexure-XII "Schedule of Supervisory Personnel".

The man-months shall be inclusive of deputation of technical experts to provide guidance to Purchaser's O&M personnel till the end of warranty period.

Bio-data of the foreign Experts/Specialists/Engineers shall be furnished to the Purchaser/Consultant for approval, sufficiently in advance, before their deputation. In case the number of man-months for foreign experts actually utilized for execution of the contract exceeds the man-months indicated in Annexure-XII the experts shall be deputed by the Contractor for such additional man-months to complete the work, but no extra payment for such additional man-months shall be payable by the Purchaser. However, in case the actual utilization is lower than that indicated in Annexure-XII, the contractor shall give a rebate on pro-rata basis.

The Contractor shall make all arrangements and pay for the deputation of such Experts/Specialists to India including their air travel, surface travel, accommodation etc.

The foreign Experts/Specialists deputed by the Contractor must have working knowledge of English language. If interpreters are required the same shall be arranged and paid for by the Contractor.

The Contractor shall furnish a schedule of deployment of supervisory personnel for Purchaser's approval. The payment will be regulated as per the approved schedule.

7.2 Leave

The period or periods of leave availed by the Experts in India or abroad shall not be reckoned for the purpose of computing the number of man months.

Notwithstanding anything contained herein, the Experts shall, however, be entitled to the Purchaser's National Holidays.

7.3 Working Hours

The Experts/Specialists shall observe normal working hours and holidays as observed by the Purchaser. The Experts/Specialists shall also be available for supervision of work, if required, beyond the normal working hours as well as in shifts round the clock including Sundays and holidays without any extra payment chargeable to the Purchaser.

7.4 Office Accommodation

The Purchaser shall provide area to the Contractor for building its office accommodation at site. After the work is over, such offices shall be handed over, free of cost, to the Purchaser.

7.5 Medical Facilities

In case of illness or accident to any of the Experts, the Contractor shall ensure and arrange the necessary medical assistance and treatment in India including treatment in nursing home. If required, the Contractor shall shift the Experts to nearby Cities for proper treatment. If an Expert/Specialist falls ill for more than two weeks, the Expert shall be replaced by the Contractor in the shortest possible time at the Contractor's cost.

7.6 Excess Baggage

The Contractor shall bear the transportation cost of instruments, tools & tackles for erection and commissioning of Plant as well as excess personal baggage to be brought by the Experts/Specialists. The Contractor shall, also make arrangement, on receipt of advance intimation for custom clearance of such instruments, tools and tackle brought by the Experts.

7.7 Registration

The Contractor shall arrange to complete registration of foreign Experts/Specialists with the nearest police station/alike office and other formalities as may be required for foreigners deputed to India.

7.8 Insurance

The Contractor shall take Accident Insurance Policy for the Experts/Specialists for adequate value to cover the full and all risks of accidents including the death and permanent disability. Two photo copies of the Insurance Policy shall be furnished by the Contractor to Purchaser.

7.9 General

The foreign Experts while deputed to India shall maintain their status as employees of the Company which deputed them and the Purchaser takes no liability in respect thereof except those provided in this Contract.

The Contractor shall remain responsible such that all the foreign experts/specialists deputed to India by him shall comply with Indian Laws.



Any person found unsuitable or not accepted or not approved by the Purchaser shall not be brought to India. If any person brought to India is found unsuitable or unacceptable by Purchaser the Contractor shall within a reasonable time make alternative arrangement for providing a suitable replacement and repatriation of such unsuitable personnel at his own cost.

No person brought to India for the purpose of the 'Works' shall be repatriated without the consent of the Purchaser in writing based on a written request from the Contractor for such repatriation giving reasons for such an action to the Purchaser. The Purchaser may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.

The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account.

The Contractor and his expatriate personnel shall respect all Indian Acts, laws, Rules and Regulations and shall not in any way, interfere with Indian political and religious affairs and shall conform to any other rules and regulations of the Government of India and the Purchaser may establish from time to time on them. The Contractor's expatriate personnel shall work and live in close co-operation and co-ordination with their co-workers and the community and shall not engage themselves in any other employment either part time or full time nor shall they take part in any local politics.

The Purchaser shall assist the Contractor, to the extent possible in obtaining necessary permits, to travel to India and back, by issue of necessary certificates and other information, needed by the Governmental agencies. Conditions of the credit Financing Agency for such travels shall apply.



ANNEXURE-XIX

SAFETY CODE FOR CONTRACTORS

1 GENERAL

- 1.1 Safety is the responsibility of every employee, individually and collectively.
- 1.2 Head of the Dept/Division should ensure that a copy of this Contractor's Safety Code is handed over to every Contractor working under his control and he should in turn prominently display all rules on the office/site notice board for the benefit of all the men working under him.
- 1.3 The Contractor shall in connection with provide adequate guards, illumination, fencing and watch wherever necessary at the construction site & working area, for the safety & convenience of general public.
- 1.4 Fire extinguishers adequate in number and with proper validity shall always be kept by the Contractor at the site of works, where there is risk of fire hazard, especially near the site stores.
- 1.5 Adequate washing facilities with proper drainage shall be provided and properly maintained near the place of work but at a safe distance from railway tracks and busy roads.
- 1.6 Whenever work is to be undertaken near a place, where there is a risk of drowning, arrangements to be made for safe barricading of such areas. All necessary equipment shall be provided and kept ready for use and necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first-aid treatment of all injuries likely to be sustained during the course of the work, in case of a mishap.
- 1.7 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be open to inspection by the Safety Engineer, the Labour Officer, Engineer-in-charge of the concerned Department or their representatives.
- 1.8 Notwithstanding the above clauses, there is nothing in these to exempt the Contractor from the operation of any other Act or Rule in the Republic of India for the safety of men and materials.
- 1.9 An injury sustained in the plant, must be immediately reported to the First-Aid Station or next higher Supervisor/Officer in-charge, no matter how minor the nature of the injury.
- 1.10 In case of a fatal accident, the Contractor must inform the Engineer in-charge of the department for which he is working and a report in writing should be made, clearly explaining the sequence of events leading to the accident.



- 1.11 Smoking or use of naked lights is strictly prohibited near gas lines, valves and any other equipment linked to the gas distribution networks.
- 1.12 Smoking and carrying of matches, lighters and other spark producing devices is strictly prohibited within the area where inflammable liquids are stored, handled or used or where loading or unloading operations are performed. Any tank or container containing inflammable liquid should be properly grounded for preventing ignition due to static electricity charges. Contractor should ear-mark such areas and provide necessary signage and warning signals.
- 1.13 Contractors should ensure that employees do not report to work while under the influence of intoxicants. Any employee found on duty under the influence of liquor or of intoxicating drugs, will be liable to severe disciplinary action.
- 1.14 Work surroundings should be kept clean, free from oil, grease and other obstructions or fallen objects like nuts bolts etc.
- 1.15 After a job or work is completed, all left-over junk and other scrap materials should be cleared from the area immediately.
- 1.16 Drums or other make-shift arrangement must not be used in place of ladders or as work benches or supports for any job.
- 1.17 Employees shall not walk through or cross any operating units unless their duties require them to do so, or they are authorised.
- 1.18 Compressed air should not be used for removing dust from one's clothes and deliberately directed or used on any person as it is likely to cause serious injury.
- 1.19 If an employee, in the course of his work, encounters conditions of unusual hazard with which he is not familiar, he should contact the supervisor for advice before proceeding further. He should also inform the Contractor as well as the Engineer in-charge.
- 1.20 Contractors should particularly ensure that they or their employees do not meddle with any equipment they are not concerned or unfamiliar with and see that they should generally keep away from such equipment.
- 1.21 It should be ensured that no one takes rest/shelter below any undercut pit/excavation or near any stock-pile of materials.
- 1.22 For any work involving repair & maintenance underground, the Contractor shall follow the safety procedural orders/instruction issued by the Purchaser.
- 1.23 The Contractor shall ensure supervision of such jobs by competent persons within the meaning of Factories Act & Rules.



- 1.24 All persons engaged on such jobs shall have to have before hand proper training instructions as required under Factories Act & Rules.

2 SAFETY MEASURES IN CONTRACT WORK

Whereas, it is necessary to take steps to ensure safety at work sites by the executing contractual agency, it is incumbent of the Purchaser to introduce all measures to guide, induce, train and bind the agencies concerned to adopt remedial steps to prevent accidents. Problem gets aggravated in contractual zones due to lack of training, in-adequate supply of personal protective equipment, shortage of skilled labour changing deployment of works etc. Accordingly, the following measures are intended to be introduced and the salient clauses will be included in the contract documents.

- 2.1 The Contractor shall take all safety precautions and provide adequate supervision in order to carry out the job safely and without damage to men & equipment.
- 2.2 Any special safety precautions, if required to be followed by the Contractor, such clauses shall be added.
- 2.3 The executing department would take necessary shut-downs wherever there are hazards of gases, electricity, moving machinery etc. The Contractor shall ensure that the shut-down/clearance are taken before deploying workers to such locations.
- 2.4 The Contractor shall supply safety appliance such as safety shoes, safety belts, helmets, gloves, harness etc. to his workers depending on working conditions and life saving jackets shall always be kept in readiness at the site. The Contractor shall not deploy any workmen without safety shoes and safety helmet and the safety applicable to the specific work conditions.
- 2.5 Before starting the day's job, the Purchaser's Supervisor/representatives will ensure that safety briefing has been done to the Contractor's supervisor who has previously been imparted safety induction training.
- 2.6 Head/Zonal in-charge will nominate Engineer in-charge of the contractual work under reference who will be fully responsible for the safe execution of the work at site.
- 2.7 In case of injury to persons, the Contractors shall first take the injured person to nearest hospital with the necessary forms. In no case the Contractors are allowed to take injured persons directly to their own Doctors.
- 2.8 The Contractor shall abide by the provisions of Factories Act, State Factory Rules, Workmen's Compensation Act, Payment of Wages Act, Contract Labour (Regulation) Act etc. and keep the Purchaser indemnified of provision the above Acts and Rules.



**Tender Specification
for
Chimney**

**NLC Tamil Nadu Power Ltd.
2x500 MW Project
Tuticorin, Tamil Nadu**

- 2.9** The Head of Department executing the contract upon the satisfaction that the Contractor is not conforming to the Safety requirements may direct stoppage of work and require the Contractor to remedy the defects. The Contractor shall not proceed with the work until he has complied with each directions to the satisfaction of such Head of the Department.
- 2.10** The Contractor shall be fully responsible for accidents caused due to him or his agents or workmen's negligence or carelessness in regard to the observance of the safety requirements and shall be liable to pay compensation for injuries.
- 2.11** Without prejudice to the right conferred by the above clause, for stoppage of work for violations of safety requirements the Contractor shall be liable for penalty as deemed fit for violation of safety rules & regulations upto first two instances. For the third violation he shall be liable to be debarred from further contracts upto a period of one year from the date of issue of debarring notice.
- 2.12** The Head of the Safety Engg. Deptt. or the Head of the Deptt. executing the contract will assess the penalty amount having regard to the circumstances, in particular, the nature and gravity of the violation. After issuing a notice to the Contractor to show cause why the amount specified therein shall not be imposed as a penalty and considering the cause shown by the Contractors, if any, he shall pass final orders which shall then be final and binding on the Contractor. The penalty amount will be recoverable from any bill and/or EMD/SD of the Contractor without any further reference to him.
- 2.13** Whenever work, at heights is involved, Contractor must obtain necessary permissions and clearances from the Safety Engg. Dept. for such persons required to do work at height.
- 2.14** Contractor must insure all the workmen under the "Workmen Compensation Act."

* * * * *





PURCHASE GENERAL CONDITIONS OF CONTRACT (GCC)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR SOUTHERN REGION



Vol-IB: General Conditions of the Contract (GCC)

Cl. No	DESCRIPTION
1.	<p>Technical bid will be opened at stipulated time on Due Date. The Technical cum Commercial bid should accompany with a copy of this enquiry duly signed & stamped on all pages as a token of acceptance of Technical & Commercial T & C and copy of documents like authorized dealership certificate, earlier supply order details of similar equipment and their performance feedback from customers, company profile and present status, product catalogue of the models offered, technical specifications of the product, commercial Terms & Conditions and other relevant documents etc. Please fill up all the columns of all formats of this enquiry.</p> <p>Price bid should be submitted as per the 'Price Format' given in this enquiry. Quotations not accompanying filled in 'Price Format' are likely to be rejected. Terms and condition if any enclosed with price bid, shall not be considered. Tenders received as single bid indicating the price is liable to be rejected.</p>
2.	Price bid of technically accepted bidders only will be opened. No revision of prices will be entertained after Tenders are opened, unless mentioned in our enquiry / asked so by BHEL.
3.	Manufacturer's name, Trade Mark or Patent No. if any, shall be specified in the Technical cum Commercial Bid
4.	Please mention the relevant national / international standard code of the product quoted for in the Technical cum Commercial bid.
5.	The purchaser shall be under no obligation to accept the lowest or any other tender and shall be entitled to accept or reject any tender in part or full without assigning any reason whatsoever.
6.	The tenders received after the specified time of their submission or treated as 'Late tenders' and shall not be considered under any circumstances.
7.	Price quoted shall be valid for 06 Months from the date of opening.
8.	Price shall be quoted as per enclosed 'Price Format' only. Quotations not accompanying filled in 'Price Format' are likely to be rejected. Please fill in all the columns of all formats
9.	<u>Performance Guarantee (PBG/CEBG)</u> : The supplier shall have to furnish Bank Guarantee (Cash/DD/Bank Guarantee from a Scheduled Bank) if so specified in the tender under Special Terms & Conditions.
10.	<u>Packing and Marking</u> : The supplier shall arrange for secure protective packing of the goods suitable for tropical conditions to avoid loss, damage, atmospheric action during handling and transit. The packing standards will comply with relevant national standard/carrier's conditions of packing or established practice. If any damage is sustained and the carrier or underwriter attributes it to improper packing, the seller shall be liable to replace the material or reimburse the value of the loss notwithstanding any transit

Cl. No	DESCRIPTION
	insurance arranged by him or not. The following marking shall be made on each package in black bold letters. NAME & ADDRESS OF CONSIGNEE, DIMENSION OF PACKAGE, WEIGHT DETAILS: GROSS, TARE & NETT These markings should be stenciled or written in bold letters on the package. Should the package be small, suitable cards/metal tags giving these details may be tagged or nailed.
11.	Inspection: Final inspection will be carried out the destination/site/Purchaser's works by the authorized inspecting Officer, if so specified in the tender under Special Terms & Conditions. Whenever preliminary or stage inspection is to be carried out at supplier's works the same is subject to final acceptance after receipt of the material at the destination/Purchasers works and the decision of the purchaser shall be final. The propriety of goods shall not pass until final acceptance by the purchaser
12.	Rejection: The seller shall intimate the purchaser in writing within 15 days (after being intimated about rejection of goods) regarding disposal action of the rejected material. If no advice is received within this time the purchaser shall be at liberty to return the material at the cost and risk of the seller after receiving the cost if any paid by the Purchaser including inward freight and other incidental charges. The Purchaser will not be responsible for the rejected material thereafter and no claim will rest on him.
13.	Delivery: Purchaser shall not be liable to receive and pay for any supply made after delivery date stipulated in the order unless the delivery date is formally extended by the purchaser. Wherever the terms of delivery of the order is other than F.O.R. destination, delivery date will be reckoned as the date of dispatch or the date of readiness after inspection of the material where the Purchaser has agreed for inspection or collection.
14.	Test Certificate: The seller shall carry out such tests as prescribed by the purchaser / as required in accordance to the relevant national or international standards, in his works and/or and other places as stipulated in the order. Necessary test certificate shall be submitted with delivery of materials. The seller shall also provide at no extra cost the required number of catalogues, drawing and other manuals related to materials under this order.
15.	<p>Terms of Payment: As per Technical Conditions of the Contract document.</p> <p>The seller shall send dispatch requisite documents, invoice etc. in such quantum and manner as provided in the order.</p> <p>(i) It is expressly understood that in the event of rejection of the materials for which payment has been made against documents through bank the Purchaser reserves the right to claim from the seller the amount paid and the incidental charged incurred in the same manner i.e. negotiating return dispatch documents, through Bank and the Seller shall honor such claim and retire the documents from the Bank.</p> <p>(ii) Bank charges for any payment claimed through Bank shall be borne by the seller and the seller shall also agree to bear any demurrage or other charges arising out of any delay in retirements or documents from Bank due to delayed, insufficient incorrect information furnished.</p> <p>(iii) The seller shall also ensure that the Carriers do not delay dispatch of the consignment once the carrier's receipt is obtained.</p>

Cl. No	DESCRIPTION
16.	<p><u>Guarantee/Warranty:</u> The materials shall be warranted for design material and workmanship and also for performance warranty as specially stipulated by the purchaser in the order in its annexure.</p>
17.	<p><u>Insurance:</u> Wherever specifically agreed to and directed, the supplier will insure the goods for all transit risks upto delivery of the goods at the final destination. In all other cases supplier must furnish particulars of dispatch for each consignment immediately after the dispatch of goods. Failure to do this will make the supplier responsible for making good any loss, which otherwise might have been recovered from underwriters.</p>
18.	<p><u>Delivery Failure, Termination & Liquidated Damage:</u> The parties hereto agree that the timely dispatch/delivery and completion of the other schedules as stipulated in order/contract shall be the essence of the Order/Contract. If the Supplier fails to complete the dispatch/ delivery and other schedules within the time period stipulated in the order/contract, or within any extension of time granted by the purchaser, it shall be lawful for the purchaser to recover damages for the breach of order/contract without prejudice to any other rights and/or remedies provided for, in order/contract and hereunder.</p> <p>The purchaser reserves the right to recover from the Supplier, as agreed liquidated damages and not by way of penalty, a sum equivalent to half percent {½% of the total contract price per week part thereof, subject to a maximum of ten percent @ 10%} of the total contract price excluding elements of taxes, duties and freight, if Supplier has failed to deliver any part of the goods within the period stipulated in the Order/Contract.</p> <p>The purchaser reserves the right to purchase from elsewhere on account of and at the risk and cost of the Supplier without notice to the Supplier of goods not so delivered or their equivalent, without canceling the order/contract in respect of the goods not yet due for delivery.</p> <p>The purchaser reserves the right to cancel the order/contract or a portion thereof for the goods not so delivered at the risk and cost of the Supplier and the Supplier shall be liable to the purchaser for any excess costs thereof.</p> <p>In case of staggered delivery schedule, LD shall be 0.5 % of the undelivered portion per week of delay or part thereof subject to a maximum of 10% of the total order value. However, even if a staggered delivery schedule for Capital Machine/ BOPs is agreed, the LD cap will be levied on total order value and not on undelivered portion of the order value.</p>
19.	<p><u>Execution of Contract</u></p> <p>The successful tenderer's responsibility under this contract commences from the date of issue of the Letter of Intent/ Purchase Order/ Work Order by Bharat Heavy Electricals Limited. The Tenderer shall submit an unqualified acceptance to the Letter of Intent/Award within the period stipulated therein.</p> <p>The successful tenderer shall be required to execute an agreement in the prescribed form, with BHEL, within a reasonable time after the acceptance of the Letter of Intent/Award, and in any case before releasing the first running bill. The contract agreement shall be signed by a person duly</p>

Cl. No	DESCRIPTION
	authorized/empowered by the tenderer. The expenses for preparation of agreement document shall be borne by BHEL.
20.	<p>Risk Purchase: In the event the supplier has failed to deliver or dispatch whole of the goods or any part within the time stipulated or if the same were not available in his stock, the best and the nearest available substitute thereof may be purchased/arranged by purchaser from elsewhere at the risk and the cost of the seller.</p>
21.	<p><u>RIGHTS OF BHEL:</u></p> <ol style="list-style-type: none"> 1) BHEL reserves the following rights in respect of this contract during the original contract period or its extensions if any, as per the provisions of the contract, without entitling the Supplier for any compensation. 2) To withdraw any portion of work and/or to restrict/alter quantum of work as indicated in the contract during the progress of work and get it done through other agencies to suit BHEL"s commitment to its customer or in case BHEL decides to advance the date of completion due to other emergent reasons/ BHEL"s obligation to its customer. 3) To terminate the contract or withdraw portion of work and get it done through other agency, at the risk and cost of the Supplier after due notice of a period of 14 days" by BHEL in any of the following cases: <ol style="list-style-type: none"> i. Supplier's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to Supplier including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution. i. Withdrawal from or abandonment of the work by Supplier before completion of the work as per contract. ii. Non-completion of work by the Supplier within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the Supplier. iv. Termination of Contract on account of any other reason (s) attributable to Supplier. v. Assignment, transfer, subletting of Contract without BHEL"s written permission. vi. Non-compliance to any contractual condition or any other default attributable to Supplier. <p><u>Risk & Cost Amount against Balance Work:</u></p> <p>Risk & Cost amount against balance work shall be calculated as follows:</p> $\text{Risk \& Cost Amount} = [(A-B) + (A \times H/100)]$ <p>Where,</p> <p>A= Value of Balance scope of Work (*) as per rates of new contract</p> <p>B= Value of Balance scope of Work (*) as per rates of old contract being paid to the Supplier at the time of termination of contract i.e. inclusive of PVC & ORC, if any.</p> <p>H = Overhead Factor to be taken as 5</p>

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	<p>In case (A-B) is less than 0 (zero), value of (A-B) shall be taken as 0 (zero).</p> <p>* Balance scope of work (in case of termination of contract):</p> <p>Difference of Contract Quantities and Executed Quantities as on the date of issue of Letter for "Termination of Contract", shall be taken as balance scope of Work for calculating risk & cost amount.</p> <p>Contract quantities are the quantities as per original contract. If, Contract has been amended, quantities as per amended Contract shall be considered as Contract Quantities.</p> <p>Items for which total quantities to be executed have exceeded the Contract Quantities based on drawings issued to Supplier from time to time till issue of Termination letter, then for these items total Quantities as per issued drawings would be deemed to be contract quantities.</p> <p>Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute/ extra items which have been executed but rates have not been approved, would also form part of contract quantities for this purpose and rates of such items shall be determined in line with contractual provisions.</p> <p>However, increase in quantities on account of additional scope in new tender shall not be considered for this purpose.</p> <p>NOTE: Incase portion of work is being withdrawn at risk & cost of Supplier instead of termination of contract, contract quantities pertaining to portion of work withdrawn shall be considered as "Balance scope of work" for calculating Risk & Cost amount.</p> <p><u>LD against delay in executed work in case of Termination of Contract:</u></p> <p>LD against delay in executed work shall be calculated in line with the LD terms cited in Tender, for the delay attributable to Supplier. For limiting the maximum value of LD, contract value shall be taken as Executed Value of work till termination of contract.</p> <p>Method for calculation of "LD against delay in executed work in case of termination of contract" is given below.</p> <ol style="list-style-type: none"> i. Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to Supplier = T1 ii. Let the value of executed work till the time of termination of contract=X iii. Let the Total Executable Value of work for which inputs/fronts were made available to Supplier and were planned for execution till termination of contract = Y iv. Delay in executed work attributable to Supplier i.e. T2=[1-(X/Y)] x T1 v. LD shall be calculated in line with the LD terms cited in Tender for the delay attributable to Supplier taking "X" as Contract Value and "T2" as period of delay attributable to Supplier.

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	<p>4) In case Supplier fails to deploy the resources as per requirement, BHEL can deploy own/hired/otherwise arranged resources at the risk and cost of the Supplier and recover the expenses incurred from the dues payable to Supplier. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.</p> <p>5) <u>Recoveries arising out of Risk & Cost and LD or any other recoveries due from Supplier</u></p> <p>Following sequence shall be applicable for recoveries from Supplier:</p> <ol style="list-style-type: none"> a. Dues available in the form of Bills payable to Supplier, SD, BGs against the same contract. b. Demand notice for deposit of balance recovery amount shall be sent to Supplier, if funds are insufficient to effect complete recovery against dues indicated in (a) above. c. If Supplier fails to deposit the balance amount to be recovered within the period as prescribed in demand notice, following action shall be taken for balance recovery: <ol style="list-style-type: none"> i. Dues payable to Supplier against other contracts in the same Region shall be considered for recovery. ii. If recovery cannot be made out of dues payable to the Supplier as above, balance amount to be recovered, shall be informed to other Regions/Units for making recovery from the Unpaid Bills/Running Bills/SD/BGs/Final Bills of Supplier. iii. In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against Supplier. <p>6) To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contract with their customer are terminated for any reason, as per mutual agreement.</p> <p>7) While every endeavor will be made by BHEL to this end, they cannot guarantee uninterrupted work due to conditions beyond their control. The Supplier will not be normally entitled for any compensation/extra payment on this account unless otherwise specified elsewhere in the contract.</p> <p>8) In case the execution of works comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than two months, due to reasons not attributable to the Supplier and other than Force Majeure conditions, BHEL may consider permitting the Supplier to de mobilize forthwith and remobilize at an agreed future date. Cost of such demobilization/remobilization shall be mutually agreed. ORC in such cases shall not be applicable for the period between the period of demobilization and re mobilization. The duration of contract/time extension shall accordingly get modified suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the Supplier.</p> <p>9) In the unforeseen event of inordinate delay in receipt of materials, drawings, fronts, etc, due to which inordinate discontinuity of work is anticipated, BHEL at its discretion may consider Supplier's request to short close the contract in following cases:</p> <ol style="list-style-type: none"> a. The balance works (including but not limited to Trial Operation, PG Test, etc) are minor vis a vis the scope of work envisaged as per the contract. b. There has been no significant work in past 6 months OR no significant work is expected in next 6

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	<p>months (example in Hydro projects or in projects where work has stopped due to reasons beyond the control of BHEL)</p> <p>c. The balance works cannot be done within a reasonable period of time as they are dependent on unit shutdown or on other facilities of customer or any other reasons not attributable to the Supplier.</p> <p>10) At the point of requesting for short closure, Supplier shall establish that he has completed all works possible of completion and he is not able to proceed with the balance works due to constraints beyond his control. In such a case, the estimated value of the unexecuted portion of work (or estimated value of services to be provided for carrying out milestone/stage payments like Trial Operation/PG Test, etc.) as mutually agreed, shall however be reduced from the final contract value.</p>
22.	<p><u>Arbitration & Conciliation:</u></p> <p><u>Arbitration:</u></p> <p>a) Except as provided elsewhere in this Contract, in case Parties are unable to reach amicable settlement (whether by Conciliation to be conducted as provided in Conciliation Clause herein below or otherwise) in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the Contract; or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or, in any manner touching upon the Contract (hereinafter referred to as the „Dispute“), then, either Party may, commence arbitration in respect of such Dispute by issuance of a notice in terms of section 21 of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the “Notice”). The Notice shall contain the particulars of all claims to be referred to arbitration in sufficient detail and shall also indicate the monetary amount of such claim. The arbitration shall be conducted by a sole arbitrator to be appointed by the Head of the BHEL Power Sector Region issuing the Contract within 60 days of receipt of the complete Notice. The language of arbitration shall be English.</p> <p>The Arbitrator shall pass a reasoned award.</p> <p>Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder as in force from time to time shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be <u>at Chennai, India.</u> The Contract shall be governed by and be construed as per provisions of the laws of India. Subject to this provision cited above regarding ARBITRATION, the principal civil court exercising ordinary civil jurisdiction over the area where the seat of arbitration is located shall have exclusive jurisdiction over any DISPUTE to the exclusion of any other court.</p> <p>b) In case of Contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable:</p> <p>In the event of any dispute or difference relating to the interpretation and application of the provisions</p>

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	<p>of commercial contract(s) between Central Public Sector Enterprises (CPSEs)/ Port Trusts inter se and also between CPSEs and Government Departments/Organizations (excluding disputes concerning Railways, Income Tax, Customs & Excise Departments), such dispute or difference shall be taken up by either party for resolution through AMRCD (Administrative Mechanism for Resolution of CPSEs Disputes) as mentioned in DPE OM No. 4(1)/2013-DPE(GM)/FTS-1835 dated 22-05-2018 as amended from time to time.</p> <p>c) The cost of arbitration shall initially be borne equally by the Parties subject to the final allocation thereof as per the award/order passed by the Arbitrator.</p> <p>d) Notwithstanding the existence of any dispute or differences and/or reference for the arbitration, the Supplier shall proceed with and continue without hindrance the performance of its obligations under this Contract with due diligence and expedition in a professional manner unless the dispute inter-alia relates to cancellation, termination or short-closure of the Contract by BHEL.</p> <p><u>CONCILIATION:</u></p> <p>If at any time (whether before, during or after the arbitral or judicial proceedings), any Disputes (which term shall mean and include any dispute, difference, question or disagreement arising in connection with construction, meaning, operation, effect, interpretation or breach of the agreement, contract), which the Parties are unable to settle mutually, arise inter-se the Parties, the same may, be referred by either party to Conciliation to be conducted through Independent Experts Committee (IEC) to be appointed by competent authority of BHEL from the BHEL Panel of Conciliators.</p> <p><u>Notes:</u></p> <ol style="list-style-type: none"> 1) No serving or a retired employee of BHEL/Administrative Ministry of BHEL shall be included in the BHEL Panel of Conciliators. 2) Any other person(s) can be appointed as Conciliator(s) who is/are mutually agreeable to both the parties from outside the BHEL Panel of Conciliators <p>The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided in Procedure 2.3 to this GCC. The Procedure 2.3 together with its Formats will be treated as if the same is part and parcel hereof and shall be as effectual as if set out herein in this GCC. The Supplier hereby agrees that BHEL may make any amendments or modifications to the provisions stipulated in the Procedure 2.3 to this GCC from time to time and confirms that it shall be bound by such amended or modified provisions of the Procedure 2.3 with effect from the date as intimated by BHEL to it.</p> <p><u>No Interest payable to Supplier:</u></p> <p>Notwithstanding anything to the contrary contained in any other document comprising in the Contract, no interest shall be payable by BHEL to Supplier on any moneys or balances including but not limited to the Security Deposit, EMD, Retention Money, RA Bills or the Final Bill, or any amount withheld and/or appropriated by BHEL etc., which becomes or as the case may be, is adjudged to be due from BHEL to</p>

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	Supplier whether under the Contract or otherwise
23.	<p><u>OTHER ISSUES</u></p> <p>a) Value of Non judicial Stamp Paper for Bank Guarantees and for Contract Agreement shall be not less than Rs.100/- unless otherwise required under relevant statutes.</p> <p>b) In case of any conflict between the General Conditions of Contract and Special Conditions of Contract, provisions contained in the Special Conditions of Contract shall prevail.</p> <p>c) Unless otherwise specified in NIT, offers from consortium/JVs shall not be considered.</p> <p>d) BHEL may not insist for signing of Contract Agreements in respect of low value and short time period contracts like providing services for Hot water flushing, Chemical Cleaning, Transportation, etc.</p> <p>e) The consultant / firm (and any of its affiliates) shall not be eligible to participate in tender/s for the related works or services for the same project, if they were engaged for the consultancy services.</p>
24.	<p><u>Suspension of Business dealings</u></p> <p>1) BHEL reserves the right to take action against Suppliers who fail to perform or indulge in malpractices, by suspending business dealings with them.</p> <p>2) Suspension could be in the form of 'Hold', 'De-listing' or 'Banning' a Supplier.</p> <p>3) A bidder may be put on HOLD for a period of 6 months, for future tenders for specific works on the basis of one or more of the following reasons:</p> <p>a) Bidder does not honour his own offer or any of its conditions within the validity period.</p> <p>b) Bidder fails to respond against three consecutive enquires of BHEL.</p> <p>c) After placement of order, Bidder fails to execute a contract.</p> <p>d) Bidder fails to settle sundry debt account, for which he is legitimately liable, within one year of its occurrence.</p> <p>e) Bidder's performance rating falls below 60% in specific category (more fully described in Chapter 'Performance Monitoring').</p> <p>f) Bidder works are under strike/ lockout for a long period.</p> <p>4) A Bidder may be de-listed from the list of registered Bidders of the region for a period of 1 year on the basis of one or more of the following reasons: -</p> <p>a) Bidder tampers with tendering procedure affecting ordering process or commits any misconduct which is contrary to business ethics.</p> <p>b) Bidder has substituted, damaged, failed to return, short returned or unauthorizedly disposed off materials/ documents/ drawings/ tools etc of BHEL.</p>

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	<p>c) Bidder no longer has the technical staff, equipment, financial resources etc. required to execute the orders/ contracts.</p> <p>5) A Bidder can be banned from doing any business with all Units of BHEL for a period of 3 years on the basis of one or more of the following reasons:</p> <p>a) Bidder is found to be responsible for submitting fake/ false/ forged documents, certificates, or information prejudicial to BHEL's interest.</p> <p>b) In spite of warnings, the Bidder persistently violates or circumvents the provisions of labour laws/ regulations/ rules and other statutory requirements.</p> <p>c) Bidder is found to be involved in cartel formation.</p> <p>d) The Bidder has indulged in malpractices or misconduct such as bribery, corruption and fraud, pilferage etc which are contrary to business ethics.</p> <p>e) The Bidder is found guilty by any court of law for criminal activity/offences involving moral turpitude in relation to business dealings.</p> <p>f) The Bidder is declared bankrupt, insolvent, has wound up or been dissolved; i.e ceases to exist for all practical purposes.</p> <p>g) Bidder is found to have obtained Official Company information/documentation by questionable means.</p> <p>h) Communication is received from the administrative Ministry of BHEL to ban the Bidder from business dealings.</p> <p>6) Contracts already entered with a Supplier before the date of issue of order of 'HOLD' or 'DE-LISTING' shall not be affected.</p> <p>7) All existing contracts with a 'BANNED' Supplier shall normally be short closed. Once the order for suspension is passed, existing offers/new offers of the Supplier shall not be entertained</p> <p>8) The above guidelines are not exhaustive but enunciate broad principles governing action against Suppliers.</p> <p>9) The above guidelines are not exhaustive but enunciate broad principles governing action against Suppliers.</p> <p>10) EMD by the tenderer shall be withheld in case any action on the tenderer is envisaged under the provision of extant "Guidelines on Suspension of business dealing with supplier/contractors" and forfeited/released based on the action as determined under these guidelines.</p> <p>11) Offers from tenderers who are under suspension (banned) by any Unit/Region/Division of BHEL shall not be considered.</p> <p>12) Tenders are liable to be rejected in case of unsatisfactory performance of the tenderer with BHEL, or tenderer under suspension (hold/banning /delisted) by any unit / region / division of BHEL or tenderers who do not comply with the latest guidelines of Ministry/Commissions of Govt. of India.</p>

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	13) BHEL reserves the right to take action against Suppliers who either fail to perform or Tenderers/Supplier who indulge in malpractices, by suspending business dealings with them in line with BHEL guidelines issued from time to time which is available at www.bhel.com.
25.	This order or any part thereof shall not be sub-contracted without the Purchaser's consent.
26.	Metric System: Supplier is requested to indicate metric system measurements in all documents.
27.	Indemnity: The Seller shall indemnify the Purchaser against any claim due to any breach of patent, negligence, defective material or injury to seller or his agent.
28.	In the event of any reduction in the price, due to change of Govt. duties after award to the work and before delivery commencement, purchaser is entitled to such reduction and may negotiate fresh price at its discretion.
29.	GENERAL: The purchaser reserves the right to split up the tender and place orders for individual item on different suppliers and also increase or decrease the quantity.
30.	<p>Force Majeure: Notwithstanding anything contained in the contract, neither the Seller nor the Buyer shall be held responsible for total or partial non execution/non- performance of any of the contractual obligations, in case such execution/performance is impeded/prevented due to occurrence of a 'Force Majeure' event not within the reasonable control of the party affected, which materially interferes or directly affects the performance of the obligations or duties under the contract. Force Majeure event means an event beyond the control of the parties to the contract including but not limited to war, Military operations of any nature, Act of God, earthquakes, floods, fire, quarantine restrictions, acts of public enemy, blockades, civil war, explosion, epidemics, insurgency, change in law or government policy etc.; however the onus of establishing the reason of delay lies with the Supplier.</p> <p>The party claiming to be affected by such Force Majeure event shall notify/inform the other party in writing without delay within a reasonable period of the occurrence and cessation of such event specifying the Force Majeure event and its effect on performance of contractual obligations. In the event of the parties hereto not agreeing that a force majeure event has occurred, the parties shall submit the dispute(s) for resolution pursuant to the provisions hereunder, provided that the burden of proof as to whether a force majeure event has occurred shall be upon the party claiming such an event.</p> <p>If it is agreed between the parties that a Force Majeure event has occurred and its effect continues for a period of 36 months, then either party shall be free to cancel the contract. However, if the effect of such event ceases within this period of 36 months, the performance of the obligations put on hold shall be resumed immediately.</p> <p>Notwithstanding the above provisions, Purchaser shall reserve the right to cancel the Order/ Contract, wholly or partly, in order to meet the overall project schedule and make alternative arrangements for completion of delivery and other schedules.</p> <p>If a war like situation has developed in a country where Sellers's works (of this PO) is located or there is political instability or civil war and Indian Embassy located in that country/Indian Government forbids or advises for not having any business dealings in that country/ region/zone, then BHEL reserves the right to</p>

	cancel the order/Contract without incurring any liability for any kind of payment or compensation to the Seller on that account.
31.	The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL web site (www.bhel.com ---> Tender Notification ---> List of Banned Firms)
32.	<p><u>MSE Clause</u></p> <p><u>Important Note:</u></p> <p>1) IF L-1 BIDDER IS OTHER THAN Micro and Small Scale Enterprises (MSEs).</p> <p>a) In tender, participating Micro and Small Scale Enterprises (MSEs) quoting price within price band of L1+15% shall also be allowed to supply a portion of requirement by bringing down their price to L1 price in a situation where L1 price is from someone other than a MSE and such MSE shall be allowed to supply up to <u>25%</u> of total tendered value. In case of more than one such MSE (L1+15%), L-3 onwards bidders will be given opportunity to match the L-1 prices, provided their predecessors in terms of Price standing refuses to match L-1 prices.</p> <p>b) Total tendered quantity shall be divided as follows:</p> <p>In the ratio of <u>75 : 18.75 : 6.25</u> (if L-1 bidder is non MSE), where <u>75%</u> order will be placed on L-1 bidder, <u>18.75%</u> on MSE and <u>6.25%</u> on MSE (owned by SC/ST) subjected to following conditions:</p>

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	<p>I. MSEs Matches L-1 price.</p> <p>II. If no MSE owned by SC/ST has participated in the tendering process, portion earmarked (6.25%) will be awarded entirely to other MSE (not owned by SC/ST) i.e. total 25% will be awarded to them.</p> <p>c) If no MSE matches the L-1 price, then entire order shall be awarded to L-1 bidder.</p> <p>2) IF L-1 BIDDER IS Micro and Small Scale Enterprises (MSEs) (NOT OWNED BY SC/ST).</p> <p>In tender, participating MSEs, owned by SC/ST, quoting price within price band of L1+15% shall also be allowed to supply a portion of requirement by bringing down their price to L1 price. MSE (owned by SC/ST) shall be allowed to supply up to 25% of total tendered value/quantity. In case of more than one such MSE (L1+15%), L3 onwards bidders will be given opportunity to match the L-1 prices, provided their predecessors in terms of Price standing refuses to match L-1 prices.</p> <p>3) IF L-1 BIDDER IS Micro and Small Scale Enterprises (MSEs) (OWNED BY SC/ST).</p> <p>100% order will go to the L-1 bidder.</p> <p>4) Participating MSEs should be registered with District Industries Centers or Khadi and Village Industries Commission or Khadi and Village Industries Board or Coir Board or National Small Industries Corporation or Directorate of Handicrafts and Handloom or Udyog Aadhaar Memorandum and their ownership is established in case they are claiming the portion earmarked for MSEs owned by SC/STs.</p> <p>5) Bidder who is claiming 6.25% of the quantity earmarked for MSEs owned by SC/STs are required to submit the documentary evidence to establish the ownership of MSE firm. Bidder should also mention the same in their techno-commercial bid. After opening of Price bids no such claim shall be entertained.</p> <p>6) Bidder who is claiming 6.25% of the quantity earmarked for MSEs owned by SC/STs are required to submit the documentary evidence to establish the ownership of MSE firm.</p> <p>a) In case of proprietary MSE, proprietor(s) shall be SC/ST.</p> <p>b) In case of partnership MSE, the SC/ST partners shall be holding at least 51% shares in the unit.</p> <p>c) In case of Private limited companies, at least 51% share shall be held by SC/ST promoters.</p> <p>Bidder should also mention the same in their techno-commercial bid. After opening of Price bids no such claim shall be entertained.</p> <p>7) Minimum of 3% reservation for women owned MSEs within the above mentioned 25% reservation shall be applicable. Bidder who is claiming 3% of the quantity earmarked for Women entrepreneurs are required to submit the documentary evidence to establish the ownership of MSE firm owned by Women entrepreneurs.</p> <p>a) In case of proprietary MSE, proprietor(s) shall be a Women.</p> <p>b) In case of partnership MSE, the Women partners shall be holding at least 51% shares in the unit.</p>

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	<p>c) In case of Private limited companies, at least 51% share shall be held by Women promoters.</p> <p>Bidder should also mention the same in their techno-commercial bid. After opening of Price bids no such claim shall be entertained.</p> <p>Note: All these preferences are applicable, subject to the submission of applicable certificates (i.e. District Industries Centers OR Khadi and Village Industries Commission OR Khadi and Village Industries Board OR Coir Board OR National Small Industries Corporation OR Directorate of Handicrafts and handloom OR Udyog Aadhaar Memorandum OR any other body specified by Ministry of Micro Small and Medium Enterprises).</p> <p>8) MSE suppliers can avail the intended benefits only if they submit along with offer, attested copies of either ENTREPRENEUR MEMORANDUM PART II certificate having deemed validity (Five years from the date of issue of acknowledgement in EM-II) or valid NSIC certificate or ENTREPRENEUR MEMORANDUM PART II certificate along with CA certificate (Format enclosed as per MSE Annex - I) applicable for the year, certifying quantum of investment in plant and machinery within the permissible limit as per the act for relevant status (Micro or small) where the deemed validity of ENTREPRENEUR MEMORANDUM PART II is over. Date to be reckoned for determining the deemed validity will be the last date of technical bid submission. Non submission of such documents will lead to consideration of their bids at par with other bidders and MSE status of such suppliers shall be shifted to Non MSE supplier till the supplier submits these documents.</p>
33.	<p>For this procurement, Public Procurement (Preference to Make in India), Order 2017 dated 15.06.2017, 28.05.2018, 29.05.2019 & 04.06.2020 and subsequent Orders issued by the respective Nodal Ministry shall be applicable even if issued after issue of this NIT but before finalization of contract/ PO/ WO against this NIT.</p> <p>In the event of any Nodal Ministry prescribing higher or lower percentage of purchase preference and/ or local content in respect of this procurement, same shall be applicable.</p>
34.	<p>In compliance with order issued by "Department of Expenditure's (DoE) Public Procurement Division ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020 , following restriction is hereby ordered under rule 144(xi) of the General Financial Rules (GFRs)2017 :</p> <p>I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.</p> <p>II. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms, or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.</p> <p>III. "Bidder from a country which shares a land border with India" for the purpose of this order means:-</p> <p>a. An entity incorporated, established or registered in such a country; or</p>

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	<p>b. A subsidiary of an entity incorporated, established or registered in such a country; or</p> <p>c. An entity substantially controlled through entities incorporated, established or registered in such a country; or</p> <p>d. An entity whose beneficial owner is situated in such a country; or</p> <p>e. An Indian (or other) agent of such an entity; or</p> <p>f. A natural person who is a citizen of such a country; or</p> <p>g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above</p> <p>IV. The beneficial owner for the purpose of (iii) above will be as under:</p> <p>1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.</p> <p>Explanation-</p> <p>a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent. of shares or capital or profits of the company;</p> <p>b. "Control" shall include the right to appoint the majority of the directors or to control the management of policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;</p> <p>2. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership or entitlement to more than fifteen percent of capital or profits of the partnership;</p> <p>3. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;</p> <p>4. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who hold the position of senior managing official;</p> <p>5. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.</p> <p>V. An agent is a person employed to do any act for another, or to represent another in dealings with third person.</p> <p>VI. (Applicable to works contracts including turnkey contract) The successful bidder shall not be allowed to sub-contract works to any Supplier from a country which shares a land border with India unless such</p>

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	<p>Supplier is registered with the Competent Authority.</p> <p>-----</p> <p><u>Model certificate for Tender:</u></p> <p>"I/we have read the clauses pertaining to Department of Expenditure's (DoE) Public Procurement Division Order (Public procurement no 1, 2 & 3 vide ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020) regarding restrictions on procurement from a bidder of a country which shares a land border with India. I/We hereby certify that I/ we, the bidder is/are not from such a country, OR if, from such country, has/have been registered with the competent authority. I/We hereby certify that I/we fulfil all the requirements in this regard and is/are eligible to be considered for this tender. (Where applicable, evidence of valid registration by the competent authority shall be attached)</p> <p><u>Model certificate for Tenders for works involving possibility of sub-contracting:</u></p> <p>"I/we have read the clauses pertaining to Department of Expenditure's (DoE) Public Procurement Division Order (Public procurement no 1, 2 & 3 vide ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020) regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to Suppliers from such a county. I/We hereby certify that this bidder is not from such a country, OR if, from such country, has been registered with the competent authority. I/We hereby certify that this bidder fulfils all the requirements in this regard and is eligible to be considered for this tender. (Where applicable, evidence of valid registration by the competent authority shall be attached)</p> <p><u>Model certificate for GeM:</u></p> <p>"I/we have read the clauses pertaining to Department of Expenditure's (DoE) Public Procurement Division Order (Public procurement no 1, 2 & 3 vide ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020) regarding restrictions on procurement from a bidder of a country which shares a land border with India. I/We hereby certify that I/ we, the vendor/bidder is/are not from such a country, OR if, from such country, has/have been registered with the competent authority. I/We hereby certify that I/we fulfil all the requirements in this regard and is/are eligible to be considered for this procurement on GeM. (Where applicable, evidence of valid registration by the competent authority shall be attached)</p>
35.	<p><u>PRICE DISCREPANCY:</u></p> <p>a) <u>Conventional (Manual) Price Bid opening:</u> In the case of price bid opening without resorting to Reverse Auction, if there are differences between the rates given by the tenderer in words and figures or in amount worked out by him, the following procedure for evaluation and award shall be followed:</p> <p>i) When there is a difference between the rates in figures and in words, the rates which corresponds to the amounts worked out by the bidder, shall be taken as correct</p> <p>ii) When the amount of an item is not worked out by the bidder or it does not correspond with the</p>

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	<p>rate written either in figure or in words, then the rate quoted by the bidder in words shall be taken as correct</p> <ul style="list-style-type: none"> ii) When the rate quoted by the bidder in figures and words tallies but the amount is not worked out correctly, the rate quoted by the bidder shall be taken as correct and not the amount. iv) In case of lump-sum price, if there is any difference between the amount in figures and in words, the amount quoted by the bidder in words shall be taken as correct. v) In case of omission in quoting any rate for one or more items, the evaluation shall be done considering the highest quoted rate obtained against the respective items by other tenderers for the subject tender. If the tenderer becomes L-1, the notional rates for the omission items shall be the lowest rates quoted for the respective items by the other tenderers against the respective omission items for the subject job and the 'Total quoted price (loaded for omissions)' shall be arrived at. However, the overall price remaining the same as quoted originally, the rates for all the items in the 'Total quoted price (loaded for omissions)' shall be reduced item wise in proportion to the ratio of 'Original' total price and the 'Total quoted price (loaded for omissions)''. vi) The 'Final Total Amount' shall be arrived at after considering the amounts worked out in line with 'i' to 'iv' above. <p>b) Reverse Auction: In case of Reverse Auction, the successful bidder shall undertake to execute the work as per overall price offered by him during the Reverse Auction process. In case of omission of rates, the procedure shall be as per 'Guidelines for Reverse Auction' enclosed.</p>
36.	<p>The bidder to declare that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications , certifications, subsidiary contract, submission or non submission of bids of any other actions to restrict competitiveness or to introduce cartelization in the bidding process.</p> <p>In case, the bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extrant policies/guidelines.</p>
37.	<p>A. <u>TAXES, DUTIES, LEVIES</u></p> <p><u>For Purchase/works other than enabling work</u></p> <ul style="list-style-type: none"> 1) All taxes excluding GST, GST Cess & BOCW Cess but including, Royalties, fees, license, deposits, commission, any State or Central Levy and other charges whatsoever, if any, shall be borne by you and shall not be payable extra. 2) Any increase of the taxes excluding GST, GST Cess & BOCW Cess, at any stage during execution including extension of the contract shall have to be borne by the contractor. Quoted/ accepted rates/ price shall be inclusive of all such requirements. Please note that since GST on output will be

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	<p>paid by BHEL separately as enumerated below, your quoted rates/ price should be after considering the Input Credit under GST law at your end.</p> <p>3) <u>GST</u> :</p> <p>The successful bidder shall furnish proof of GST registration .GST along with Cess (as applicable) legally leviable & payable by the successful bidder as per GST Law, shall be paid by BHEL. Hence Bidder shall not include GST along with Cess (as applicable) in their quoted price.</p> <p>4) GST charged in the Tax Invoice/Debit note by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return</p> <p>5) E-invoicing under GST has been implemented with effect from 1st October 2020 for all the taxable persons having turnover more than the threshold limit in any preceding financial year from 2017-18 onwards. Therefore, for all the taxable persons falling under the purview of E-invoice, it is mandatory to mention a valid unique Invoice Reference No. (IRN) and QR code as generated from E-Invoicing portal of the Government for the purpose of issuing a valid Tax Invoice. Only an E-invoice issued in the manner prescribed under rule 48(4) of CGST Rules shall be treated as valid invoice for reimbursement of GST amount.</p> <p>If the successful Bidder is not falling under the preview of E-Invoicing then he has to submit a declaration in that respect along with relevant financial statements.</p> <p>6) Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred there under) wherein the 'Bill To' details will as below :-</p> <p>BHEL GSTN – As per annexure -1 NAME -- Bharat Heavy Electricals Limited ADDRESS – Site address</p> <p>7) Bidder to immediately intimate on the day of removal of Goods(in case of any supply of goods) to BHEL along with all relevant details and a scanned copy of Tax Invoice to below email ids to enable BHEL to meet its GST related compliances :-</p> <p>Email id to be intimated later on.</p> <p>In case of delay in submission of the abovementioned documents on the date of dispatch, BHEL may incur penalty /interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from the successful bidder, if such delay is not attributable to BHEL.</p> <p>8) In case of raising any Supplementary Tax Invoice (Debit / Credit Note) Bidder shall issue the same containing all the details as referred to in Section 34 read with Rule 53.</p>

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	<p>9) Bidder shall note that in case GST credit is delayed/ denied to BHEL due to delayed / non receipt of goods and /or tax invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons not attributable to BHEL, GST amount shall be recoverable from the vendor along with interest levied / leviable on BHEL, as the case may be.</p> <p>10) Bidder shall upload the Invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law , GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the bidder along with interest levied / leviable on BHEL.</p> <p>11) Way Bill: Successful Bidder to arrange for way bill / e-waybill for any transfer of goods for the execution of the contract.</p> <p>The Bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the works under this contract, Road Permit/ Way Bill, if required, shall be arranged by the contractor and BHEL will not supply any Road Permit/ Way Bill for this purpose.</p> <p>12) <u>New taxes and duties:</u> -Any New taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period including extension, if the same is not attributable to you, shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties.</p> <p>Benefits and/or abolition of all existing taxes must be passed on to BHEL against new Taxes, if any, proposed to be introduced at a later date.</p> <p>In case any new tax/levy/duty etc. becomes applicable after the date of bidder's offer but before opening of the price bid, the bidder must convey its impact on his price duly substantiated by documentary evidence in support of the same before opening of the price bids. Claim for any such impact after opening the price bid will not be considered by BHEL for reimbursement of tax or reassessment of offer.</p> <p>13) For transportation work, bidder shall declare in his quotation whether he is registered under GST, if yes, whether he intends to claim GST on forward charge basis. In absence of this declaration, BHEL will proceed further with the assumption that bidder intends not to claim GST on forward charge basis. However, in case of GST registered transporter, the amount to the extent of goods and service tax will be retained till BHEL avails the credit of GST. Further, transporter shall issue tax invoice which inter alia includes gross weight of the consignment, name of the consigner and the consignee, registration number of vehicle in which the goods are transported, details of goods transported, details of place of origin and destination, GSTIN of the person liable for paying tax whether as consigner, consignee or goods transport agency, and also containing other information as mentioned under rule 46.</p>

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	<p>14) TDS under Income Tax shall be deducted at prevailing rates on gross invoice value from the running bills unless exemption certificate from the appropriate authority/ authorities is furnished.</p> <p>15) TDS under GST shall be deducted at prevailing rates on applicable value from the running bills.</p> <p>16) TCS under Income Tax 1961 has been implemented with effect from 1st October 2020 for every seller having turnover more than threshold limit during financial year immediately preceding financial year in which the sale of goods is carried out, who receives any amount as consideration for sale of any goods of the value or aggregate of such value exceeding threshold limit other than export of goods or who is already covered under other provision of section 206C, collect from the buyer, TCS as per applicable rates of the sale consideration exceeding threshold limit subject to following conditions</p> <ol style="list-style-type: none"> 1. Buyer shall be as per clause (a) of section 206C- (1H) 2. Seller shall be as per clause (b) of section 206C- (1H) 3. No TCS is to be collected, if the seller is liable to collect TCS under other provision of section 206C or the buyer is liable to deduct TDS under any provision of the Act and has deducted such amount. <p>If Successful Bidder is falling under the purview of TCS then he has to submit a declaration in that respect along with relevant financial statements before the start of work or if bidder is falling under preview of TCS during the work in progress then bidder is compulsorily required to submit relevant financial statement in the beginning of the respective FY.</p> <p>For TCS claim, vendor has to submit relevant documents required as per Income Tax Act.</p> <p><u>GSTIN of BHEL for Tamil Nadu 33AAACB4146P2ZL</u></p>
38.	<p><u>Cancellation of Order:</u></p> <p>In the event of non-performance of the contract by the Supplier, BHEL reserves the right to cancel the order with issue of a written notice. BHEL would provide a curing period of 30 days, for the Supplier to rectify the situation. If the Supplier fails to rectify the reason/s that led to the issue of cancellation notice by BHEL, then the cancellation order would be issued automatically by BHEL, without further recourse to the Seller. BHEL will not pay any cancellation charges or any other charges / damages to the Supplier, arising out such cancellation. In the event of the non-performance of the supply contract, by the Supplier, the rights of BHEL include, in addition to cancelling the order, to take alternate purchase action at the cost and risk of the supplier. The additional expenditure to be incurred by BHEL in such alternate purchase would be to the account of the supplier (Risk Purchase). This remedy would be in addition to the invoking of the PBG/CEBG on grounds of failure of the Supplier in executing the Contract and any other legal remedies. BHEL reserves the right to initiate the alternate purchase action at the cost and risk of the erring supplier by issue of a simple notice of intention for the alternate purchase action duly sent by any electronic means and / or by a letter. The cancellation of the order would not be a pre-condition for initiation of the alternate purchase action.</p>

General Terms and Conditions

39.

1. **Shortages/Damages**: If there are any Shortages/Damages observed in the Equipment/Item during the receipt of material at Destination/Site, Supplier shall supply those shortages as per the contract delivery terms, unless and otherwise specified elsewhere. BHEL decision will be final as regards to Shortages/Damages.
2. **Rejection**: The seller shall intimate the purchaser in writing within 15 days (after being intimated about rejection of goods) regarding disposal action of the rejected material. If no advice is received within this time the purchaser shall be at liberty to return the material at the cost and risk of the seller after receiving the cost if any paid by the Purchaser including inward freight and other incidental charges. The Purchaser will not be responsible for the rejected material thereafter and no claim will rest on him.
3. **Insurance**: Wherever specifically agreed to and directed, the supplier will insure the goods for all transit risks upto delivery of the goods at the final destination. In all other cases supplier must furnish particulars of dispatch for each consignment immediately after the dispatch of goods. Failure to do this will make the supplier responsible for making good any loss, which otherwise might have been recovered from underwriters.
4. **Metric System**: Supplier is requested to indicate metric system measurements in all documents.
5. **Indemnity**: The Seller shall indemnify the Purchaser against any claim due to any breach of patent, negligence, defective material or injury to seller or his agent.
6. The language in the tender documents downloaded by the Bidders shall at no point of time be changed, altered or modified in any manner by the Tenderer. If such changes are made by any tenderer, it shall be considered as tampering with BHEL's terms and the offer shall be summarily rejected, whenever it is noticed by BHEL. Such Bidders would be disqualified from the Bidding Process and their offers would be forfeited / Bank Guarantees invoked. They would also not be allowed to take part in future tenders of BHEL.

Volume-IC: Forms and Procedures

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OFFER FORWARDING LETTER / TENDER SUBMISSION LETTER

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

Offer Reference No:.....

Date:.....

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : Submission of Offer against Tender Specification No:

I/We hereby offer to carry out the work detailed in the Tender Specification issued by Bharat Heavy Electricals Limited, Power Sector-....., in accordance with the terms and conditions thereof.

I/We have carefully perused the following listed documents connected with the above work and agree to abide by the same.

- 1. Amendments/Clarifications/Corrigenda/Errata/etc issued in respect of the Tender documents by BHEL
- 2. Notice Inviting Tender (NIT)
- 3. Price Bid
- 4. Technical Conditions of Contract
- 5. Special Conditions of Contract
- 6. General Conditions of Contract
- 7. Forms and Procedures

Should our Offer be accepted by BHEL for Award, I/we further agree to furnish 'Security Deposit' for the work as provided for in the Tender Conditions within the stipulated time as may be indicated by BHEL.

I/We further agree to execute all the works referred to in the said Tender documents upon the terms and conditions contained or referred to therein and as detailed in the appendices annexed thereto.

I/We have deposited/depositing herewith the requisite Earnest Money Deposit (EMD) as per details furnished in the Check List.

Authorised Representative of Bidder

Signature :
Name :
Address :

Place:
Date:

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration by Authorised Signatory**

Ref : 1) NIT/Tender Specification No..... ,

2) All other pertinent issues till date

I/We, hereby certify that all the information and data furnished by me with regard to the above Tender Specification are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations and all other pertinent issues till date, and agree to comply with the requirements and Intent of the specification.

I further certify that I am authorised to represent on behalf of my Company/Firm for the above mentioned tender and a valid Power of Attorney to this effect is also enclosed.

Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Date:

Enclosed: Power of Attorney

NO DEVIATION CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **No Deviation Certificate**

Ref : 1) NIT/Tender Specification No..... ,
2) All other pertinent issues till date

We hereby confirm that we have not changed/ modified/materially altered any of the tender documents as downloaded from the website/ issued by BHEL and in case of such observance at any stage, it shall be treated as null and void.

We also hereby confirm that we have neither set any Terms and Conditions and nor have we taken any deviation from the Tender conditions together with other references applicable for the above referred NIT/Tender Specification.

We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and acceptance to Reverse Auctioning process.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Date:

Place:

DECLARATION CONFIRMING KNOWLEDGE ABOUT SITE CONDITIONS

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration confirming knowledge about Site conditions**

Ref : 1) NIT/Tender Specification No..... ,

2) All other pertinent issues till date

I/We, _____ hereby declare and confirm that we have visited the Project Site as referred in BHEL Tender Specifications and acquired full knowledge and information about the Site conditions including Wage structure, Industrial Climate, the Law & Order and other conditions prevalent at and around the Site. We further confirm that the above information is true and correct and we shall not raise any claim of any nature due to lack of knowledge of Site conditions.

I/We, hereby offer to carry out work as detailed in above mentioned Tender Specification, in accordance with Terms & Conditions thereof.

Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Date:

Place:

DECLARATION FOR RELATION IN BHEL

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration for relation in BHEL**

Ref : 1) NIT/Tender Specification No..... ,

I/We hereby submit the following information pertaining to relation/relatives of Proprietor/Partner(s)/Director(s) employed in BHEL

Tick (✓) any one as applicable:

1. The Proprietor, Partner(s), Director(s) of our Company/Firm DO NOT have any relation or relatives employed in BHEL

OR

2. The Proprietor, Partner(s), or Director(s) of our Company/Firm HAVE relation/relatives employed in BHEL and their particulars are as below:

(i)

(ii)

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Note:

1. Attach separate sheet, if necessary.
2. If BHEL Management comes to know at a later date that the information furnished by the Bidder is false, BHEL reserves the right to take suitable against the Bidder/Contractor.

NON DISCLOSURE CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

NON DISCLOSURE CERTIFICATE

I/We understand that BHEL is committed to Information Security Management System as per their Information Security Policy.

Hence, I/We M/s..... who are submitting offer for providing services to BHEL against Tender Specification No.: _____, hereby undertake to comply with the following in line with Information Security Policy of BHEL.

- To maintain confidentiality of documents & information which shall be used during the execution of the Contract.
- The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHEL.

Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Date:

BANK ACCOUNT DETAILS FOR E-PAYMENT

(To be given on Letter head of the Company /Firm of Bidder, and **ENDORSED (SIGNED & STAMPED) BY THE BANK** to enable BHEL release payments through Electronic Fund Transfer (EFT/RTGS)

1. Beneficiary Name :

2. Beneficiary Account No. :

3. Bank Name & Branch :

4. City/Place :

5. 9 digit M ICR Code of Bank Branch :

6. IFSC Code of Bank Branch :

7. Beneficiary E-mail ID
(for payment confirmation) :

Note: In case Bank endorsed certificate regarding above has already been submitted earlier, Kindly submit photocopy of the same

FORMAT FOR SEEKING CLARIFICATION

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Request for Clarification**

Ref : 1) NIT/Tender Specification No..... ,

2) All other pertinent issues till date

S. No	Reference clause of Tender Document	Existing provision	Bidder's query	BHEL's clarification
1.				
2.				
3.				
4.				
5.				
6.				

Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Date:

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector Southern Region
CONTRACT AGREEMENT

AGREEMENT NO. _____

SCOPE OF SUPPLY	
NAME OF THE SUPPLIER WITH FULL ADDRESS	
PURCHASE ORDER NO.	
PURCHASE ORDER VALUE	
DELIVERY SCHEDULE (DATE OF COMPLETION)	

SIGNATURE OF SUPPLIER_____
SIGNATURE OF BHEL OFFICER

CONTRACT AGREEMENT

THIS AGREEMENT MADE THIS _____ DAY OF _____ between BHARAT HEAVY ELECTRICALS LIMITED (A Government of India Enterprise) a Company incorporated under the Companies Act, 1956, having its Registered Office at BHEL House, Siri Fort New Delhi- 110049 (herein after called BHEL) of the ONE PART.

AND

M/S _____
_____ (hereinafter called the 'Contractor') of the SECOND PART.

WHEREAS M/s-----state that they have acquired and possess extensive experience in the field of _____
And Whereas in response to an Invitation to Tender No. ----- issued by BHEL for execution of -----
-----the contractor submitted their offer No.----- dated-----
And whereas BHEL has accepted the offer of the Contractor on terms and conditions specified in the Letter of Intent No.-----dated----- read with the references cited therein.

THIS AGREEMENT WITNESSES AND it is hereby agreed by and between the parties as follows:

1. That the contractor shall execute the work of -----and more particularly described in Tender Specification No -----including Drawings and Specifications (hereinafter called the said works) in accordance with and subject to terms and conditions contained in these presents, instructions to Tenderers, General Conditions of Contract, Special Conditions, Annexures, Letter of Intent dated ----- and such other instructions, Drawings, Specifications given to him from time to time by BHEL.
2. The Contractor is required to furnish to BHEL Security deposit in the form of cash/ approved securities/ Bank Guarantee valid upto ----- for a sum of Rs -----towards satisfactory performance and completion of the Contract.
3. The Contractor has furnished a Bank Guarantee bearing no.-----dated -----for a sum of Rs.-----
-----executed by ----- in favour of BHEL towards Security Deposit valid upto -----

OR

The Contractor has furnished to BHEL an initial Security Deposit of Rs ----- in the form of cash / approved Securities/ B.G No.----- dated ----- for Rs.-----executed by ----- in favour of BHEL valid upto -----and has agreed for recovery of the balance security deposit by BHEL @ 10% of the value of work done from each running bill till the entire Security Deposit is recovered.

OR

The contractor has furnished to BHEL an initial Security Deposit of Rs.----- (Rs.----- vide Bank draft No.-----
-----dated -----and by adjusting EMD of Rs.-----submitted vide Bank draft No.----- dt.-----

) and has agreed for recovery of balance Security Deposit by BHEL @ 10% of the value of work done from each running bill till the entire security deposit is recovered.

4. The Contractor hereby agrees to extend the validity of the Bank Guarantee for such further period or periods as may be required by BHEL and if the Contractor fails to obtain such extension(s) from the Bank, the Contractor, shall pay forthwith or accept recovery of Rs----- from the bills in one installment and the contractor further agrees that failure to extend the validity of the Bank Guarantee or failure to pay the aforesaid amount in the manner specified above shall constitute breach of contract. In addition to above, BHEL shall be entitled to take such action as deemed fit and proper for recovering the said sum of Rs.....

OR

In case the contractor furnishes the bank guarantee at a later date the contractor hereby agrees to extend the validity of bank guarantee for such further period or periods as may be required by BHEL and if the contractor fails to obtain such extension(s) from the bank, the contractor shall pay forthwith or accept recovery of the amount of bank guarantee given in lieu of security deposit from the bills in one installment and the contractor further agrees that failure to extend the validity of bank guarantee or failure to pay the aforesaid amount in the manner specified above shall constitute breach of contract. In addition to above, BHEL shall be entitled to take such action as deemed fit and proper for recovering the said sum.

5. That in consideration of the payments to be made to the Contractor by BHEL in accordance with this Agreement the Contractor hereby covenants and undertakes with BHEL that they shall execute, construct, complete the works in conformity, in all respects, with the terms and conditions specified in this Agreement and the documents governing the same.
6. That the Contractor shall be deemed to have carefully examined this Agreement and the documents governing the same and also to have satisfied himself as to the nature and character of the Works to be executed by him.
7. That the Contractor shall carry out and complete the execution of the said works to the entire satisfaction of the Engineer or such other officer authorised by BHEL, within the agreed time schedule, the time of completion being the essence of the Contract.
8. That BHEL shall, after proper scrutiny of the bills submitted by the Contractor, pay to him during the progress of the said works such sum as determined by BHEL in accordance with this Agreement.
9. That this Agreement shall be deemed to have come into force from----- the date on which the letter of intent has been issued to the Contractor.
10. That whenever under this contract or otherwise, any sum of money shall be recoverable from or payable by the Contractor, the same may be deducted in the manner as set out in the General Conditions of Contract or other conditions governing this Agreement.
11. That all charges on account of Octroi, Terminal and other taxes including sales tax or other duties on material obtained for execution of the said works shall be borne and paid by the Contractor.

12. That BHEL shall be entitled to deduct from the Contractor's running bills or otherwise Income Tax under Section 194 (C) of the Income Tax Act, 1961.
13. That BHEL shall be further entitled to recover from the running bills of the Contractor or otherwise such sum as may be determined by BHEL from time to time in respect of consumables supplied by BHEL, hire charges for tools and plants issued (Where applicable) and any other dues owed by the Contractor.
14. That it is hereby agreed by and between the parties that non- exercise, forbearance or omission of any of the powers conferred on BHEL and /or any of its authorities will not in any manner constitute waiver of the conditions hereto contained in these presents and the liability of the Contractor with respect to compensation payable to BHEL or Contractor's obligations shall remain unaffected.
15. It is clearly understood by and between the parties that in the event of any conflict between the Letter of Intent and other documents governing this Agreement, the provisions in the Letter of Intent shall prevail.
16. The following documents
 1. Invitation to Tender No.....
and the documents specified therein.
 2. Contractor's Offer No.....
dated.....
 3. _____
 4. _____
 5. _____
 6. Letter of Intent No _____ dated _____.
 7. _____

shall also form part of and govern this Agreement.

IN WITNESS HEREOF, the parties hereto have respectively set their signatures in the presence of

WITNESS

(Supplier)

(to be signed by a person holding
a valid Power of Attorney)

1.

2.

WITNESS

(For and on behalf of BHEL)

1.

2.

BANK GUARENTEE FOR SUPPLY FREE ISSUE MATERIAL

Bank Guarantee No:

Date:

To

NAME & ADDRESSES OF THE BENEFICIARY:

Dear Sirs,

In consideration of Bharat Heavy Electricals Limited¹ (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at _____¹ through its Unit at _____ (Name of the Unit) having awarded to _____² (Name of the Vendor / Contractor / Supplier), with its registered office at _____² (hereinafter called "the Vendor/Contractor/Supplier" which expression shall include its successors and permitted assigns) a contract Ref No. _____ dated _____³ valued at Rs. _____ (Rupees _____)/FC _____ (in words _____) for _____⁴ (hereinafter called the 'Contract')

AND WHEREAS the Employer having agreed as per the terms and conditions of the Contract to supply free issue material costing Rs. _____ for the manufacture/fabrication of the equipment at the 'Contractor/Supplier/Fabricator's' site on furnishing of a Bank Guarantee for Rs./FC _____ (Rupees/FC _____)⁵ in the manner hereinafter specified for the due safeguard of the free issue material,

we, _____ (hereinafter referred to as the Bank), having registered/Head office at _____ and inter alia a branch at _____ being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer any sum or sums upto a maximum amount but not exceeding Rs./FC _____ (Rupees/FC _____) without any demur, merely on a demand from the Employer and without any reservation, protest and recourse and without the Employer needing to prove or demonstrate reasons for its such demand.

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the 'Contractor/Supplier/Fabricator in any suit or proceeding pending before any Court or Tribunal or Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the 'Contractor/Supplier/Fabricator' shall have no claim against us for making such payment.

We the _____ Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and till the reconciliation of the free issue material has been carried out and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We _____ Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said 'Contractor/Supplier/Fabricator' from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier/Fabricator and to forbear or enforce any of the terms and conditions relating to the said Contract and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said 'Contractor/Supplier/Fabricator' or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said 'Contractor/Supplier/Fabricator' or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor/Supplier/Fabricator and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's/Supplier's/ Fabricator's liabilities.

This Guarantee shall remain in force upto and including _____⁶ and shall be extended from time to time for such period as may be desired by Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/ Supplier/ Fabricator but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the _____⁷ we shall be discharged from all liabilities under this guarantee thereafter.

We, _____ BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Any claim or dispute arising under the terms of this Guarantee shall be subject to the exclusive jurisdiction of the court at Chennai only.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed _____⁵

b) This Guarantee shall be valid up to _____⁶

c) Unless the Bank is served a written claim or demand on or before _____⁷ all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

Dated _____

Place of Issue _____

¹ NAME AND ADDRESS OF THE EMPLOER. i.e. Bharat Heavy Electricals Limited

² NAME AND ADDRESS OF THE CONTRACTOR / SUPPLIER/ FABRICATOR.

³ DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE

⁴ PROJECT/SUPPLY DETAILS AND CONTRACT VALUE

⁵ BG AMOUNT IN FIGURES AND WORDS

⁶ VALIDITY DATE

⁷ DATE OF EXPIRY OF CLAIM PERIOD

BANK GUARENTEE FOR PERFORMANCE SECURITY

Bank Guarantee No:

Date:

To

NAME & ADDRESSES OF THE BENEFICIARY:

Dear Sirs,

In consideration of Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at _____¹ through its Unit at _____ (Name of the Unit) having awarded to (Name of the Vendor / Contractor / Supplier) with its registered office at _____² hereinafter referred to as the 'Vendor / Contractor / Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No. _____ dated _____³ valued at Rs. _____⁴ (Rupees _____) / FC _____ (in words _____) for _____⁵ (hereinafter called the 'Contract') and the Vendor / Contractor / Supplier having agreed to provide a Contract Performance Bank Guarantee, equivalent to ____% (____Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we, _____ (hereinafter referred to as the Bank), having registered/Head office at _____ and inter alia a branch at _____ being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer any sum or sums upto a maximum amount of Rs. _____⁶ (Rupees _____) without any demur, immediately on first demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand.

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Vendor / Contractor / Supplier in any suit or proceeding pending before any Court or Tribunal, Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the Vendor / Contractor / Supplier shall have no claim against us for making such payment.

We the _____ bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract/satisfactory completion of the performance guarantee period as per the terms of the Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We _____ BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Vendor / Contractor / Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Vendor / Contractor / Supplier and to forbear or enforce any of the terms and conditions relating to the said Contract and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Vendor / Contractor / Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Vendor / Contractor / Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Vendor / Contractor / Supplier and notwithstanding any security or other guarantee that the Employer may have in relation to the Vendor / Contractor / Supplier 's liabilities.

This Guarantee shall remain in force upto and including _____⁷ and shall be extended from time to time for such period as may be desired by Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Vendor / Contractor / Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the _____⁸ we shall be discharged from all liabilities under this guarantee thereafter.

We, _____ BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Any claim or dispute arising under the terms of this Guarantee shall be subject to the exclusive jurisdiction of the court at Chennai only.

Notwithstanding anything to the contrary contained hereinabove:

- a) The liability of the Bank under this Guarantee shall not exceed _____⁶
- b) This Guarantee shall be valid up to _____⁷
- c) Unless the Bank is served a written claim or demand on or before _____⁸ all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this

guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

Dated _____

Place of Issue _____

¹ NAME AND ADDRESS OF EMPLOYER i.e. Bharat Heavy Electricals Limited

² NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

³ DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE

⁴ CONTRACT VALUE

⁵ PROJECT/SUPPLY DETAILS

⁶ BG AMOUNT IN FIGURES AND WORDS

⁷ VALIDITY DATE

⁸ DATE OF EXPIRY OF CLAIM PERIOD

FORM for EXTENSION OF VALIDITY OF BANK GUARANTEE

- 1. To be typed on non-judicial Stamp Papers of value as applicable in the State of India from where the BG has been issued or the State of India where the BG shall be operated
- 2. The non-judicial stamp papers shall be purchased in the name of the Party on whose behalf the BG is being issued or the BG issuing Bank

BANK GUARANTEE No:

Date:.....

To

(Write Designation and Address of Officer of BHEL inviting the Tender)

Dear Sir

Sub : Validity of Bank Guarantee No:..... Dated for..... Rs
 in favour of yourself, expiry date, on account of M/s
 in respect of Contract Number..... , (herein after called the
 Original bank Guarantee)

At the request of M/s....., weBank, having its branch Office at
 and having Head office at....., do hereby extend our liability under
 the above mentioned Bank Guarantee number..... datedfor a further period of
Months/years from to expire on

Except as provided above, all other terms and conditions of the Original Bank Guarantee No
 Dated shall remain unaltered and binding on us.

Kindly treat this extension as an integral part of the original Bank Guarantee to which it would be attached.

Yours faithfully

Signature.....

Name & Designation.....

Power of Attorney/Signing Power No

Seal of Bank

KNOW ALL MEN BY THESE PRESENTS, that I/We do hereby make, nominate, constitute and appoint Mr , whose signature given below herewith to be true and lawful Attorney of M/s..... hereinafter called 'Company', for submitting Tender/entering into Contract and inter alia, sign, execute all papers and to do necessary lawful acts on behalf of Company with M/s Bharat Heavy Electricals Ltd, Power Sector_____Region,_____ in connection with
..... vide Tender Specification No : _____, dated_____.

And the Company do hereby agree to ratify and confirm all acts, deeds, things or proceedings as may be lawfully done by the said attorney and by or on behalf of the company and in the name of the company, by virtue of the powers conferred herein and the same shall be binding on the company and shall have full force and effect.

IN WITNESS WHEREOF the common seal of the company has been hereunto affixed in the manner hereinafter appearing on the document.

Dated at _____, this _____ day of _____

Director/CMD/Partner/Proprietor

Signature of Mr.....(Attorney)

Attested by: Director/CMD/Partner/Proprietor

Witness

Notary Public

STATEMENT OF CLAIMS/COUNTER CLAIMS TO BE SUBMITTED TO THE IEC BY BOTH THE PARTIES

1. Chronology of the Disputes
2. Brief of the Contract/MoU/Agreement/LOI/LOA
3. Brief history of the Disputes:
4. Issues:
5. Details of Claim(s)/Counter Claim(s):

Sl. No.	Description of claim(s)/Counter Claim	Amount (in INR)Or currency applicable in the contract	Relevant contract clause

6. Basis/Ground of claim(s)/counter claim(s) (along with relevant clause of contract)

Note– *The Statement of Claims/Counter Claims may ideally be restricted to maximum limit of 20 pages. Relevant documents may be compiled and submitted along with the statement of Claims/Counter Claims. The statement of Claims/Counter Claims is to be submitted to all IEC members and to the other party by post as well as by email.*

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY BHEL FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

M/s. (Stakeholder's name)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY BHEL**

Ref: ContractNo../MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which arise out of the above-referred Contract/MoU/Agreement/LOI/LOA are reproduced hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring disputes to conciliation.

In terms of Clause -----of Procedure i.e., Annexure to the Contract/MoU /Agreement / LOI / LOA, we hereby seek your consent to refer the matter to Conciliation by Independent Experts Committee to be appointed by BHEL. You are invited to provide your consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which you might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA.

Please note that upon receipt of your consent in writing within 30 days of the date of receipt of this letter by you, BHEL shall appoint suitable person(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of BHEL

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY A STAKEHOLDER FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,
BHEL (Head of the Unit/Division/Region/Business Group)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY A STAKEHOLDER**

Ref: ContractNo../MoU/Agreement/LOI/LOA& date_____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which have arisen out of the above-referred Contract/MoU/Agreement/LOI/LOA are enumerated hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring inter-se disputes of the Parties to conciliation.

We wish to refer the above-said disputes to Conciliation as per the said Clause of the captioned Contract/MoU/Agreement/LOI/ LOA. In terms of Clause -----of Procedure i.e., Annexure ----- to the Contract/MoU /Agreement / LOI / LOA, we hereby invite BHEL to provide its consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which it might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA and to appoint suitable person(s) as Conciliator(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of the Stakeholder

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT FOR INTIMATION TO THE STAKEHOLDER ABOUT APPOINTMENT OF CONCILIATOR/IEC

To,

M/s. (Stakeholder's name)

Subject: **INTIMATION BY BHEL TO THE STAKEHOLDER AND CONCILIATOR(S) ABOUT APPOINTMENT OF CONCILIATOR/IEC**

Ref: ContractNo../MoU/Agreement/LOI/LOA& date_____.

Sir,

This is with reference to letter dated_____ regarding reference of the disputes arising in connection with the subject Contract No/MoU/Agreement/LOI/LOA to conciliation and appointment of Conciliator(s).

In pursuance of the said letter, the said disputes are assigned to conciliation and the following persons are nominated as Conciliator(s) for conciliating and assisting the Parties to amicably resolve the disputes in terms of the Arbitration & Conciliation Act, 1996 and the Procedure ---- to the subject Contract /MoU/Agreement/LOI/LOA, if possible.

Name and contact details of Conciliator(s)

- a)
- b)
- c)

You are requested to submit the Statement of Claims or Counter-Claims (strike off whichever is inapplicable) before the Conciliator(s) in Format 30 (enclosed herewith) as per the time limit as prescribed by the Conciliator(s).

Yours faithfully,

Representative of BHEL

CC: To Conciliator(s)... for Kind Information please.

Encl: As above

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

PROCEDURE FOR CONDUCT OF CONCILIATION PROCEEDINGS

1. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided herein:
2. The party desirous of resorting to Conciliation shall send an invitation/notice in writing to the other party to conciliate specifying all points of Disputes with details of the amount claimed. The party concerned shall not raise any new issue thereafter. Parties shall also not claim any interest on claims/counter-claims from the date of notice invoking Conciliation till the conclusion of the Conciliation proceedings. If BHEL is to initiate Conciliation, then, the invitation to Conciliate shall be extended to the concerned Stakeholder in **Format 31** hereto. Where the stakeholder is to initiate the Conciliation, the notice for initiation of Conciliation shall be sent in **Format-32** hereto.
3. The party receiving the invitation/notice for Conciliation shall within 30 days of receipt of the notice of Conciliation intimate its consent for Conciliation along with its counter-claims, if any.
4. The Conciliation in a matter involving claim or counter-claim (whichever is higher) up to Rs 5 crores shall be carried out by sole Conciliator nominated by BHEL while in a matter involving claim or counter-claim (whichever is higher) of more than Rs 5 crores Conciliation shall be carried out by 3 Conciliators nominated by BHEL. The appointment of Conciliator(s) shall be completed and communicated by the concerned Department/Group of BHEL Unit/Division/Region/Business Group to the other party and the Conciliator(s) within 30 days from the date of acceptance of the invitation to conciliate by the concerned party in the **Format-33**. The details of the Claim, and counter-claim, if any, shall be intimated to the Conciliator(s) simultaneously in **Format-30**.
5. The Parties shall be represented by only their duly authorized in-house executives/officers and neither Party shall be represented by a Lawyer.
6. The first meeting of the IEC shall be convened by the IEC by sending appropriate communication/notice to both the parties as soon as possible but not later than 30 days from the date of his/their appointment. The hearings in the Conciliation proceeding shall ordinarily be concluded within two (2) months and, in exceptional cases where parties have expressed willingness to settle the matter or there exists possibility of settlement in the matter, the proceedings may be extended by the IEC by a maximum of further 2 months with the consent of the Parties subject to cogent reasons being recorded in writing.
7. The IEC shall thereafter formulate recommendations for settlement of the Disputes supported by reasons at the earliest but in any case within 15 days from the date of conclusion of the last hearing. The recommendations so formulated along with the reasons shall be furnished by the IEC to both the Parties at the earliest but in any case within 1 month from the date of conclusion of the last hearing.
8. Response/modifications/suggestions of the Parties on the recommendations of the IEC are to be submitted to the IEC within time limit stipulated by the IEC but not more than 15 days from the date of receipt of the recommendations from the IEC.

9. In the event, upon consideration, further review of the recommendations is considered necessary, whether by BHEL or by the other Party, then, the matter can be remitted back to the IEC with request to reconsider the same in light of the issues projected by either/both the Parties and to submit its recommendations thereon within the following 15 days from the date of remitting of the case by either of the Parties.
10. Upon the recommendations by the Parties, with or without modifications, as considered necessary, the IEC shall be called upon to draw up the Draft Settlement Agreement in terms of the recommendations.
11. When a consensus can be arrived at between the parties only in regard to any one or some of the issues referred for Conciliation the draft Settlement Agreement shall be accordingly formulated in regard to the said Issue(s), and the said Settlement Agreement, if signed, by the parties, shall be valid only for the said issues. As regards the balance issues not settled, the parties may seek to resolve them further as per terms and conditions provided in the contract.
12. In case no settlement can be reached between the parties, the IEC shall by a written declaration, pronounce that the Conciliation between the parties has failed and is accordingly terminated.
13. Unless the Conciliation proceedings are terminated in terms of para 22 (b), (c) & (d) herein below, the IEC shall forward his/its recommendations as to possible terms of settlement within one (1) month from the date of last hearing. The date of first hearing of Conciliation shall be the starting date for calculating the period of 2 months.
14. In case of 3 members IEC, 2 members of IEC present will constitute a valid quorum for IEC and meeting can take place to proceed in the matter after seeking consent from the member who is not available. If necessary, videoconferencing may be arranged for facilitating participation of the members. However, the IEC recommendations will be signed by all members. Where there is more than one (1) Conciliator, as a general rule they shall act jointly. In the event of differences between the Members of IEC, the decision/recommendations of the majority of the Members of IEC shall prevail and be construed as the recommendation of the IEC.
15. The Draft Settlement Agreement prepared by the IEC in terms of the consensus arrived at during the Conciliation proceedings between the Parties shall be given by the IEC to both the parties for putting up for approval of their respective Competent Authority.
16. Before submitting the draft settlement agreement to BHEL's Competent Authority viz. the Board Level Committee on Alternative Dispute Resolution (BLCADR) for approval, concurrence of the other party's Competent Authority to the draft settlement agreement shall be obtained by the other party and informed to BHEL within 15 days of receipt of the final draft settlement agreement by it. Upon approval by the Competent Authority, the Settlement Agreement would thereafter be signed by the authorized representatives of both the Parties and authenticated by the members of the IEC.
17. In case the Draft Settlement Agreement is rejected by the Competent Authority of BHEL or the other Party, the Conciliation proceedings would stand terminated.

18. A Settlement Agreement shall contain a statement to the effect that each of the person(s) signing thereto (i) is fully authorized by the respective Party(ies) he/she represents, (ii) has fully understood the contents of the same and (iii) is signing on the same out of complete freewill and consent, without any pressure, undue influence.
19. The Settlement Agreement shall thereafter have the same legal status and effect as an arbitration award on agreed terms on the substance of the dispute rendered by an arbitral tribunal passed under section 30 of the Arbitration and Conciliation Act, 1996.
20. Acceptance of the Draft Settlement Agreement/recommendations of the Conciliator and/or signing of the Settlement Agreement by BHEL shall however, be subject to withdrawal/closure of any arbitral and/or judicial proceedings initiated by the concerned Party in regard to such settled issues.
21. Unless otherwise provided for in the agreement, contract or the Memorandum of Understanding, as the case may be, in the event of likelihood of prolonged absence of the Conciliator or any member of IEC, for any reason/incapacity, the Competent Authority/Head of Unit/Division/Region/Business Group of BHEL may substitute the Conciliator or such member at any stage of the proceedings. Upon appointment of the substitute Conciliator(s), such reconstituted IEC may, with the consent of the Parties, proceed with further Conciliation into the matter either de-novo or from the stage already reached by the previous IEC before the substitution.
22. The proceedings of Conciliation under this Scheme may be terminated as follows:
- a. On the date of signing of the Settlement agreement by the Parties; or,
 - b. By a written declaration of the IEC, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of the declaration; or,
 - c. By a written declaration of the Parties addressed to the IEC to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,
 - d. By a written declaration of a Party to the other Party and the IEC, if appointed, to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,
 - e. On rejection of the Draft Settlement Agreement by the Competent Authority of BHEL or the other Party.
23. The Conciliator(s) shall be entitled to following fees and facilities:

SI No	Particulars	Amount
1	Sitting fees	Each Member shall be paid a Lump Sum fee of Rs 75,000/- for the whole case payable in terms of paragraph No. 27 herein below.
2	Towards drafting of settlement agreement	In cases involving claim and/or counter-claim of up to Rs 5crores. Rs 50,000/- (Sole Conciliator)

SI No	Particulars	Amount
		<p>In cases involving claim and/or counter-claim of exceeding Rs 5 crores but less than Rs 10 crores. Rs 75,000 (per Conciliator)</p> <p>In cases involving claim and/or counter-claim of more than Rs 10 crores. Rs 1,00,000/- (per Conciliator)</p> <p>Note: The aforesaid fees for the drafting of the Settlement Agreement shall be paid on the, Signing of the Settlement Agreement after approval of the Competent Authority or Rejection of the proposed Settlement Agreement by the Competent Authority of BHEL.</p>
3	Secretarial expenses	<p>Rs 10,000/- (one time) for the whole case for Conciliation by a Sole Member IEC.</p> <p>Where Conciliation is by multi member Conciliators – Rs 30,000/- (one time)- to be paid to the IEC</p>
4	<p>Travel and transportation and stay at outstation Retired Senior Officials of other Public Sector Undertakings (pay scale wise equivalent to or more than E-8 level of BHEL)</p> <p>Others</p>	<p>As per entitlement of the equivalent officer (pay scale wise) in BHEL.</p> <p>As per the extant entitlement of whole time Functional Directors in BHEL.</p> <p>Ordinarily, the IEC Member(s) would be entitled to travel by air Economy Class.</p>
5	Venue for meeting	<p>Unless otherwise agreed in the agreement, contract or the Memorandum of Understanding, as the case may be, the venue/seat of proceedings shall be the location of the concerned Unit / Division / Region / Business Group of BHEL. Without prejudice to the seat/venue of the Conciliation being at the location of concerned BHEL Unit / Division / Region / Business Group, the IEC after consulting the Parties may decide to hold the proceedings at any other place/venue to facilitate the proceedings. Unless, Parties agree to conduct Conciliation at BHEL premises, the venue is to be arranged by either Party alternately.</p>

SI No	Particulars	Amount

24. The parties will bear their own costs including cost of presenting their cases/evidence/witness(es)/expert(s) on their behalf. The parties agree to rely upon documentary evidence in support of their claims and not to bring any oral evidence in IEC proceedings.
25. If any witness(es) or expert(s) is/are, with the consent of the parties, called upon to appear at the instance of the IEC in connection with the matter, then, the costs towards such witness(es)/expert(s) shall be determined by the IEC with the consent of the Parties and the cost so determined shall be borne equally by the Parties.
26. The other expenditures/costs in connection with the Conciliation proceedings as well as the IEC's fees and expenses shall be shared by the Parties equally.
27. Out of the lump sum fees of Rs 75,000/- for Sitting Fees, 50% shall be payable after the first meeting of the IEC and the remaining 50% of the Sitting Fees shall be payable only after termination of the conciliation proceedings in terms of para 22 hereinabove.
28. The travelling, transportation and stay at outstation shall be arranged by concerned Unit as per entitlements as per Serial No. 4 of the Table at para 23 above, and in case such arrangements are not made by the BHEL Unit, the same shall be reimbursed to the IEC on actuals limited to their entitlement as per Serial No. 4 of the Table at Para 23 above against supporting documents. The IEC Member(s) shall submit necessary invoice for claiming the fees/reimbursements.
29. The Parties shall keep confidential all matters relating to the conciliation proceedings. Confidentiality shall extend also to the settlement agreement, except where its disclosure is necessary for purposes of its implementation and enforcement or as required by or under a law or as per directions of a Court/Governmental authority/ regulatory body, as the case may be.
30. The Parties shall not rely upon or introduce as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the Disputes that is the subject of the Conciliation proceedings:
 - a. Views expressed or suggestions made by the other party in respect of a possible settlement of the Disputes;
 - b. admissions made by the other party in the course of the Conciliator proceedings;
 - c. proposals made by the Conciliator;
 - d. The fact that the other Party had indicated his willingness to accept a proposal for settlement made by the Conciliator.
31. The Parties shall not present the Conciliator(s) as witness in any Alternative Dispute Resolution or Judicial proceedings in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

- 32.** None of the Conciliators shall act as an arbitrator or as a representative or counsel of a Party in any arbitral or judicial proceeding in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.
- 33.** The Parties shall not initiate, during the Conciliation proceedings, any arbitral or judicial proceedings in respect of a Disputes that is the subject matter of the Conciliation proceedings except that a Party may initiate arbitral or judicial proceedings where, in his opinion, such proceedings are necessary for preserving his rights including for preventing expiry of period of limitation. Unless terminated as per the provisions of this Scheme, the Conciliation proceedings shall continue notwithstanding the commencement of the arbitral or judicial proceedings and the arbitral or judicial proceedings shall be primarily for the purpose of preserving rights including preventing expiry of period of limitation.
- 34.** The official language of Conciliation proceedings under this Scheme shall be English unless the Parties agree to some other language.