

**TAMIL NADU GENERATION DISTRIBUTION CORPORATION
LTD. (TANGEDCO)
1X800 MW TANGEDCO NORTH CHENNAI STAGE-III**

**TECHNICAL SPECIFICATION
FOR
VIBRATION ISOLATION SYSTEM
FOR**

**TD BFP (2 NOS) FOUNDATION
MD BFP (1 NOS) FOUNDATION**

SPECIFICATION NO.: PE-TS-423-614-C001 (Rev 0)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA-201301**



TITLE :
TECHNICAL SPECIFICATION FOR
VIS FOR TD BFP (2 NOS) & MD BFP(1
NOS.) FOUNDATION

SPECIFICATION NO. PE-TS-423-614-C001

SECTION

REV. NO. 0

DATE 01.08.2017

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This Technical Specification consists of two Sections:

SECTION I

- **SPECIFIC TECHNICAL REQUIREMENTS.**

SECTION II

- **STANDARD TECHNICAL SPECIFICATION.**
- **REFERENCE QUALITY PLAN**



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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

01. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
02. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations.'
03. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
04. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
05. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description& quantities as per the specification shall prevail).
06. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.

The charges for 3rd party inspection (Lloyds, or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

07. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval.
08. GA drawings/ datasheet / QP as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
09. All sub vendors shall be subject to BHEL/CUSTOMER approval.
10. Any special tools & tackles, if required, shall be in bidder's scope.



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SECTION-I
SPECIFIC TECHNICAL REQUIREMENTS



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1.0 SCOPE

1.01 SUPPLY OF VIBRATION ISOLATION SYSTEM (VIS):

- i) Vibration Isolation System (VIS)
- ii) Tools and facilities required for erection and commissioning including seaworthy packing & transportation etc. complete.

1.02 SUPERVISION OF ERECTION AND COMMISSIONING OF THE VIS.

Vendor shall deploy experienced manpower for setting the VIS in position and final adjustments after machine installation. Vendor shall also confirm the readiness at site before deploying the manpower for supervision of erection. Vendor shall furnish proposed erection strategy of the entire system and procedure for replacement of VIS and downtime involved.

1.03 DESIGN & ENGINEERING FOR THE VIBRATION ISOLATION SYSTEM AND TOP DECK (INCLUDED IN VENDOR'S SCOPE)

Design and engineering shall consist of the following:

- i) Selection of Vibration Isolation System (VIS).
- ii) Static and dynamic analysis and design of RCC deck slab (supporting arrangement for the equipment supported on VIS)
- iii) Calculation of loads on supporting structure along with their points of application and deflection limitations.
- iv) Calculation should establish that not more than 5 % of the dynamic loads are transmitted to the substructure supporting VIS and that the foundation system meets the amplitude/frequency requirements.
- v) Checking of stiffness for structure supported on VIS.

1.04 DOCUMENTATION

Vendor shall furnish following documents:

- i) Bill of materials of various elements included in the supply along with detailed specifications of system and various items included in supply and standards local or international standards to which they conform.
- ii) General Arrangement (GA) drawing showing location and supporting details of VIS. **(Included in vendor's scope).**
- iii) GA and reinforced concrete details drawings for deck slab including bar bending schedule. **(Included in vendor's scope).**
- iv) Embedment drawings showing location of all embedment and their details pertaining to RCC deck slab. **(Included in vendor's scope).**
- v) Design document. **(Included in vendor's scope).**
- vi) Methodology of providing the shuttering and its removal as well as concreting of deck slab, installation of VIS and sequence of above operation.
- vii) Installation and maintenance manual indicating equipment, procedures, etc. necessary for installation/maintenance of VIS.
- viii) List of power plants where such systems have been successfully installed for such applications.



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- ix) Performance certificate from the end user/customer for at least two successfully executed contracts for such system.

2.0 GENERAL:

- 2.1 In case of any conflict between section –I and section-II, section-I will prevail over section-II.
- 2.2 Vibration Isolation system (VIS) shall consist of steel helical springs and viscous damper.
- 2.3 The isolation efficiency of the foundation system comprising RCC deck and steel helical springs shall be at least 90%.
- 2.4 The ratio of actual spring supported weight to the nominal spring capacity shall be at least 0.8.
- 2.5 At least 3% to 5% of critical damping shall be provided in the form of viscous dampers.
- 2.6 Bidder shall quote based on the input drawings as per Table-1 to satisfy the design requirement as per the relevant applicable codes in annexure- A and section - II.

Table-1

<u>Sl. No</u>	<u>TITLE</u>	<u>DRAWING NO.</u>
1	GENERAL ARRANGEMENT OF TDBFP-A & B SET(SH1/1)	HY-DG-1-18000-57826(R0)
2	FOUNDATION ARRANGEMENT FOR BFP & DRIVE TURBINE(SH1/3)	HY-DG-1-31301-16535(R1)
3	FOUNDATION ARRANGEMENT FOR BFP & DRIVE TURBINE(SH2/3)	HY-DG-1-31301-16535(R1)
4	FOUNDATION ARRANGEMENT FOR BFP & DRIVE TURBINE(SH3/3)	HY-DG-1-31301-16535(R1)
5	GENERAL ARRANGEMENT OF MDBFP SET (SH1/1)	HY-DG-1-18000-57827(R0)
6	FOUNDATION ARRANGEMENT OF MDBFP SET(SH1/1)	HY-DG-1-18000-57825(R0)
7	FOUNDATION ARRANGEMENT OF MDBFP SET(SH1/1)	HY-DG-1-18000-57825(R0)

- 2.7 Bidder shall furnish the information about the entire range of spring units, damper units and spring cum damper units, manufactured by the vendor. The information to be furnished should include the load carrying capacity, stiffness (vertical & horizontal), damping resistance, dimension of spring and damper units as well as quality plan.

- 2.8 The steel helical springs and viscous damper supplied should be of proven make.



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3.0 DOCUMENTS TO BE SUBMITTED BY VENDOR

3.1 Document submission schedule after the award of contract shall be as below:

PACKAGE	BHEL DRG NO	DRG TITLE	Drg Submission schedule
VIS FOR TD/MD BFP FOUNDATION	Primary Documents - affecting Manufacturing/ Delivery Directly		
	PE-V0-423-614-C201	Data sheet of VIS for BFP Foundation	R-0 within Two (02) weeks from LOI/PO & subsequent revisions within 10 days of comments received from BHEL/customer.
	PE-V0-423-614-C202	QAP of VIS for BFP Foundation	
	PE-V0-423-614-C203	Test certificate of VIS for BFP Foundation	
	PE-V0-423-614-C204	Static & dynamic Analysis of VIS for MD BFP Foundation	
	PE-V0-423-614-C205	Static & dynamic Analysis of VIS for TD BFP Foundation	
	PE-DG-423-614-C001	Civil GA drwg of MD BFP Foundation	
	PE-DG-423-614-C004	Civil GA drwg of TD BFP Foundation	
	Secondary Documents - NOT affecting Manufacturing / Delivery Directly		
	PE-DG-423-614-C002	RC details of Top Deck of MD BFP Foundation	R-0 within Two (02) weeks of Cat-I(or)II approval on GA drawing
	PE-DG-423-614-C003	Bar bending schedule of MD BFP Foundation	
	PE-DG-423-614-C005	RC details of Top Deck of TD BFP Foundation(Part 1of 6)	
	PE-DG-423-614-C011	Bar bending schedule of TD BFP Foundation	

3.2 The documents shall be submitted as mentioned below:

- Soft copy of all documents/drawings shall be furnished in pdf and AutoCAD format as applicable.
- Hard copies shall also be submitted.
- Submission of civil drawings/documents shall be as mentioned in the table-2.

Table-2

	Drawing	Document
For Approval	Soft copy + 10 nos. hard copies	Soft copy + 10 nos. hard copies
For RFC	Soft copy + 8 nos. hard copies	



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4.0 SEISMIC LOADING:

The seismic zone shall be Zone-III as per IS 1893. Importance factor (1.75) shall be taken as Table 2 of IS1893: Part4 & response reduction factor will be taken from Table 7 of IS: 1893-2002 with 100% of mass participation. Ductile detailing in accordance with IS 13920 shall be adopted for all concrete structures which is mandatory for zone-III. Response spectrum method shall be used for seismic analysis sufficient mode of vibration

Zone factor: 0.16

Importance factor: 1.75

5.0 WIND LOADING:

Wind loading will be in accordance with Indian Standard Code IS: 875 (Part 3). Basic wind speed shall be 50 m/sec. Terrain Category-2 shall be considered for all structures

6.0 MATERIAL OF CONSTRUCTION

- i. Minimum grade of concrete: M25.
- ii. Reinforcing bars will be TMT bars of grade Fe500 conforming to IS-1786.

7.0 MATERIAL (DESIGN & SUPPLY)

7.1 Steel helical springs and viscous dampers shall consist of:

- i. Steel helical spring units and viscous dampers along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads, etc.
 - ii. Frames for pre-stressing of spring elements.
 - iii. Suitable hydraulic jack system including electric pumps, high pressure tubes etc. required for the erection, alignment etc. of the spring units. One set of extra hydraulic jacks, and hand Operated pumps shall also be provided.
 - iv. Any other items may be required for the pre-stressing, erection, release of pre-stress, alignment and commissioning of the steel helical springs and viscous dampers.
- 7.2 The sizes of the spring units, damper units, spring cum damper units should be such that groups of such units can be accommodated on column heads in case of elevated foundations and on Pedestals/walls in case of foundations at ground level.
- 7.3 The steel helical springs and viscous dampers shall be designed for ensuring "fit and forget" guarantee.

8.0 MANUFACTURING & TESTING

8.1 Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the vendor. For this purpose the vendor shall submit the detailed programme for approval of customer and take up the manufacturing / testing after approval of such programme. The programme (quality plan) shall include:

- i. Manufacturing schedule and quality check exercised during manufacturing.
- ii. Detail of test to be carried out at the manufacturing shop with its schedule.
- iii. Special requirements, if any, regarding concreting of top deck.



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- iv. Complete step- by- step procedure covering the installation and commissioning of the spring system.
- v. Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers.
- vi. A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers.
- vii. Checklist for equipment required at each stage of erection.
- viii. Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.
- ix. Bill of material (data sheet) for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc. with their rating and numbers.
- x. Any other details which may be necessary to facilitate design and construction of the foundations / structures.

8.2 The springs shall conform to codes DIN 2089 and DIN 2096. The quality assurance and inspection procedure shall be finalised on the basis of the above codes and the quality plans be drawn accordingly.

9.0 ERECTION AND COMMISSIONING AND SUPERVISION

- 9.1 Complete erection and commissioning of the steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. all shall be supervised by a specialist supervisor.
- 9.2 The scope of work shall be deemed to include all activities, which may not have been explicitly mentioned but are reasonably implied for the successful commissioning of steel helical springs and viscous dampers.

10.0 REALIGNMENT OF SPRING SYSTEM

If any realignment of the steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the vendor.

11.0 TRANSPORTATION

- 11.1 Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit and handling.
- 11.2 The vendor shall be responsible for any loss or damage during transportation, handling.

12.0 INSPECTION REQUIREMENTS

- 12.1 Minimum requirement for quality plan shall be as per quality plan attached in section –II of the specification. Quality plan shall be subject to approval during detail engineering. No price implication shall be admissible to QP approval by BHEL/Customer.
- 12.2 Inspection for imported item shall be done from third party like Lloyd or equivalent and certificate shall be submitted for review of BHEL.
- 12.3 In case of new bidder, bidder may need to carry out damping test, stiffness test etc. during customer approval stage before price bid opening. No price implication shall be admissible for these tests.



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ANNEXURE-A

Codes and Standards

Latest revision of following codes shall be used for the design of the spring-supported foundations:

IS: 456	Codes practice for plain and reinforced concrete.
IS: 2974	Code of practice for design and construction of machine foundations.
IS: 1893	Criteria for earthquake resistant design of structures.
DIN: 4024	Machine foundations; Flexible supporting structures for machine with rotating masses
DIN: 2089	Helical compression springs out of round wire and rod: calculation & design.
DIN: 2096	Helical compression springs out of round wire and rod: quality requirements for hot formed compression springs.
VDI: 2056	Criteria for assessing mechanical vibrations of machine.
VDI: 2060	Criteria for assessing the state of balance of rotating rigid bodies.



TITLE :
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VIBRATION ISOLATION SYSTEM

SPECIFICATION NO. PE-TS-999-600-C026

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SECTION-II

STANDARD TECHNICAL SPECIFICATION



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1.0 SCOPE :

This section covers supply, supervision of erection commissioning & design engineering of the vibration isolation system (VIS) suitable for ID/PA/FD Fans/ TDBFP/MDBFP/ TURBOGENERATORS/ MILLS. The vibration isolation system shall be of proven make and should be in successful operation for similar machines.

2.0 SUPPLY OF VIBRATION ISOLATION SYSTEM (VIS)

VIS shall be supplied complete along with recommended spares if any. The selection of VIS shall be done by the vendor, in case not done by customer so that the amplitude at bearing locations are within permissible limits as per machine supplier recommendation or ISO 10816 whichever is governing and no dynamic loads are transferred to structure supporting VIS. Minimum 90% isolation shall be achieved and the system shall be capable of withstanding Seismic/Wind forces.

3.0 SUPERVISION OF ERECTION AND COMMISSIONING

3.01 Manual

Vendor shall supply installation and maintenance manual indicating equipment procedures etc. necessary for installation and replacement of VIS with downtime involved.

3.02 Tools and facilities

Vendor shall supply all tools and facilities as required for successful erection and commissioning of VIS. Vendor shall deploy experienced manpower to supervise successful installation of VIS.

4.0 DESIGN ENGINEERING OF VIBRATION ISOLATION SYSTEM

4.01 Dynamic Analysis

The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. Isolation efficiency of at least 90% shall be obtained. The fundamental natural frequency shall be sufficiently above or below the frequency corresponding to operating speed. Vibration amplitude shall be calculated at all bearing locations and shall satisfy the permissible limits as per ISO 10816 or as specified by the machine supplier. Transient analysis shall be carried out for the short circuit / blade failure condition with an appropriate force function if required by the machine supplier. The forces for which substructure is to be designed shall be furnished.

4.02 Static Analysis

The static analysis shall include the

- a) Dead weights of machine stationary parts
- b) Dead weights of machine rotary parts
- c) Loads due to machine power torque
- d) Loads due to maximum allowable unbalance
- e) Temperature loads
- f) Loads due to blade unbalance/short circuit
- g) Erection loads
- h) Seismic loads
- i) Any other loads given by the supplier

Various loads combinations must be investigated to obtain the most severe loads for



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foundation design purpose as per relevant IS codes or as per machine supplier recommendation whichever is more critical.

4.03 CHECK FOR SHAFT MISALIGNMENT

Foundation deck must be adequately stiff to withstand all operating load combinations without excessively upsetting the rotor shaft alignment. The structural design must carefully be analysed for relative deflection for the members supporting machine shaft to satisfy the limits as given by machine supplier if any.

4.04 DESIGN OF RCC DECK SUPPORTED ON VIS

Vendor shall provide General arrangement drawing of deck showing location and supporting detail of VIS, all embedment and their details as per the machine supplier drawing.

RCC design shall be done by working stress method for all machine foundations. Minimum reinforcement shall be governed by IS: 2974 as well IS:456.

All documents/drawings shall be supplied in 25 (twenty five) prints. All calculations shall be supplied in 6 (six) sets. Soft copy of the drawings in Auto Cad shall be supplied along with the soft copy of the documents supplied. All documentation shall be in English language and all RCC/structural design shall be conforming to the relevant Indian Standard Code of practice.

5.0 QUALITY PLAN AND TEST CERTIFICATE

Vendor shall furnish the quality plan and Test certificate for the hardware in their scope of supply. The quality plan shall be reviewed by BHEL/Consultant wherein the inspection and hold points shall be indicated. Vendor shall submit test certificate based on approved quality plan. Despatch of material by the vendor shall only take place after the receipt of Material Dispatch Clearance Certificate (MDCC) issued by BHEL/Consultant on the basis of test reports/test certificates submitted by the Vendor after manufacture.

6.0 ENVIRONMENTAL PROTECTION

VIS shall be suitably protected against environmental damages e.g. abrasion, discolouration, corrosion, oily water etc. to give a prolonged service matching the plant life.



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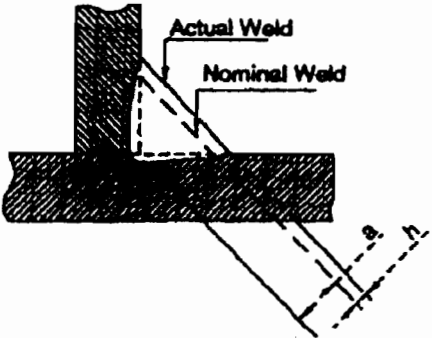
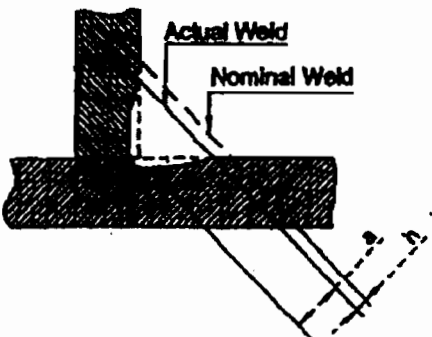
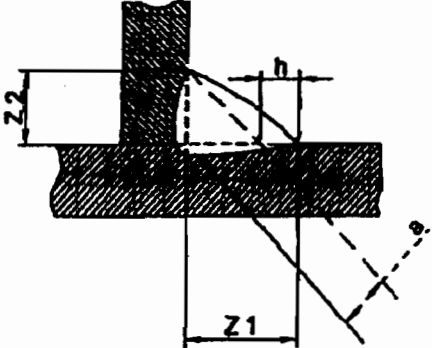
SECTION-II

REFERENCE QUALITY PLAN

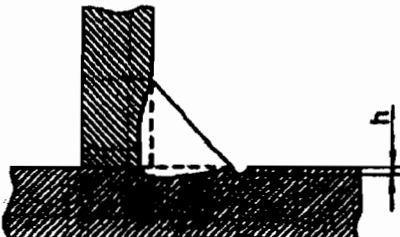
Manufacturer's logo		Manufacturer's name and Address			MANUFACTURING QUALITY PLAN (I-QAP)					Project: Main supplier: BHEL BHEL P.O NO:				
Sl. No.		Component and Operation		Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norms	Format of Record	Agency			Remarks
1		2		3	4	5	6	7	8	9	10			11
1		2		3	4	5	6	7	8	9	10			11
Materials														
1.1	For boxes		Chemical/Mechanical	Minor	Verify	One / Heat	IS 2062/DIN EN 10025/JMT 02/JVHHT 01800/SAIL/MA 350 H/2A/ILMA 350 or equivalent	Same as column 7	Certificate	✓	P	V	V	
1.2	For Springs		a) Chemical b) Grain Size c) Nkl d) Micro structure	Major	Verify	One / Lot	50 Cr V 4 As per DIN 17221 or 51 Cr V 4 As per EN 10089 or Equivalent ASTM E 112	Same as column 7	Certificate	✓	P	V	V	
1.3	Spring at Manufacturer's end		Hardness	Major	Test	One / Lot	IS 1500	ASTM 5 or finer	Certificate	✓	P	V	V	
1.4	Spring at Manufacturer's end		Decarburization	Major	Test	One / Lot	IS 6396	ABCD series T/H-2.0/1.5	Certificate	✓	P	V	V	
1.5	Spring at Manufacturer's end		NDE after compression	Major	Test	100%	IS 3703	DIN 17221 or equivalent	Certificate	✓	P	V	V	
1.6	Spring (at vendor end)		Spring Rate	Major	Test	AQL 4.0	DIN 2098	415-450 BHN	Certificate	✓	P	V	V	
1.7	Adhesive pads (4x16) 4mm thick, Steel shims		Dimensions (mm)	Minor	Measure / Visual	5 %	Drawing	Max. depth 0.5% of bar dia - partial	Lab Register	✓	P	V	V	
1.8	Viscous liquid		Penetration speed (mm/sec)	Major	Test	Sample	DIN 53019 or equivalent	Same as column 7	Internal Record	✓	P	V	V	
1.9	Studs & Nuts		Chemical Dimensions (mm)	Minor	Verify Measure	One / Lot	IS 1367 (Grade 8.8 & Class 8) IS 4216 (Tolerance Class 6g & 6h)	Same as column 7	Certificate	✓	P	V	V	
In Process Inspection														
2.1	Welding		Visual / Surface exam (mm)	Major	Visual / Measure	10% on welds	Annexure-1 (attached)	Same as column 7	Certificate	✓	P	V	V	
2.2	Boxes		NDE	Major	DPT	10% Random	ASTM / E 165	Same as column 7	Certificate	✓	P	V	V	
Final Inspection														
3.1	Shot Blasting		Picture	Major	Compare	10%	EN ISO 12944-4	SA - 2 1/2	Certificate	✓	P	V	V	
3.2	Painting		Thickness (180 microns)	Major	Measure / Visual	10%	Annexure-2 (attached)	Same as column 7	Certificate	✓	P	V	V	
3.3	Spring Unit		Dimensions (Except HF BHV)	Minor	Measure	10%	Drawing / Datasheet	EN ISO 13920 C	Internal Record	✓	P	W	V	
3.4	Constant of Spring Units (Vertical, Kv)		Load Vs Displacement (kN/mm)	Critical	Test	10%	DIN 2098 & DIN 2089	Data Sheet	Certificate	✓	P	W	V	
3.5	Document Control		Verification of above documents (IC/IR)	Major	Compare	All	MCP	Same as column 7	Certificate	✓	P	V	V	
3.6	Packing / Marking		Visual	Major	Visual / Compare	100%	As per vendor's standard	Same as column 7	Certificate	✓	P	V	V	
MANUFACTURER/ SUB-CONTRACTOR														
CONTRACTOR														
LEGEND: \$ RECORDS IDENTIFIED WITH TCK SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION M: MANUFACTURER/ SUB-CONTRACTOR C: MAIN SUPPLIER, B: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION														
SIGNATURE REVIEWED BY NAME & SIGNATURE OF APPROVING AUTHORITY WITH SEAL														

ANNEXURE - 1
WELDING

WELDING DETAILS

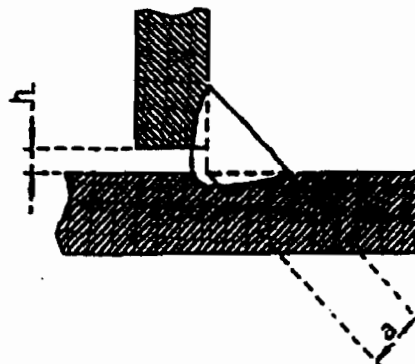
SI No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
1.	Excessive convexity		$h \leq 1\text{mm} + 0.25\text{ } b : \text{max. } 5\text{mm}$
2.	Fillet weld having a throat thickness smaller than the nominal value	 <p>A fillet weld with an apparent throat thickness smaller than that prescribed should not be regarded as being imperfect if the actual throat thickness with a compensating greater depth of penetration complies with the nominal value.</p>	<p>Short imperfections: $h \leq 0.3\text{ mm} + 0.1\text{ } a ; \text{max. } 2\text{mm}$</p> <p>Long imperfections: Not Permitted</p>
3.	Excessive asymmetry of fillet weld	 <p>It is assumed that the asymmetric fillet weld has not been expressly prescribed.</p>	$h \leq 2\text{mm} + 0.2\text{ } a$

WELDING DETAILS

SI No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
4.	Undercut	 <p>Smooth transition is required</p>	$h \leq 1.5\text{mm}$
5.	Gas pores and porosity	<p>The following conditions and limits for imperfections shall be fulfilled</p> <p>a) Maximum dimension of the summation of the projected or surface crack area of the imperfection.</p> <p>b) Maximum dimension of a single pore for -butt welds -fillet welds</p> <p>c) Maximum dimension for a single pore</p>	<p>4%</p> <p>$d \leq 0.5 s$ $d \leq 0.5 a$</p> <p>5 mm</p>
6.	Localised (clustered) porosity	<p>The total pore area within the cluster should be summed and calculated as a percentage of the greater of the two areas; an envelop surrounding all the pores or a circle with a diameter corresponding to the weld width.</p> <p>The permitted porous area should be local. The possibility of masking other imperfections should be taken into consideration.</p> <p>The following conditions and limits for imperfections shall be fulfilled:</p> <p>a) Maximum dimension of the summation of the projected or surface crack area of the imperfection</p> <p>b) Maximum dimension of a single pore for -butt weld -fillet weld</p> <p>c) Maximum dimension for localised clustered porosity.</p>	<p>16%</p> <p>$d \leq 0.5 s$ $d \leq 0.5 a$</p> <p>4mm</p>

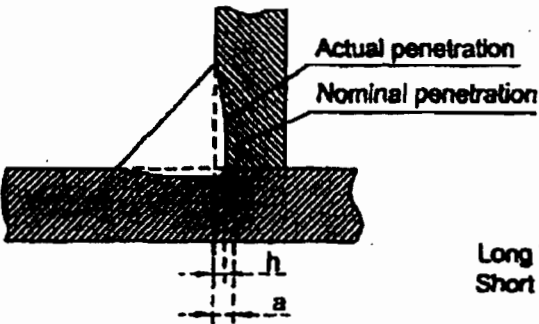
WELDING DETAILS			
Sl No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
7.	Elongated cavities, worm holes	Long imperfections for	
		-butt welds	$h \leq 0.5 s$
		-fillet welds	$h \leq 0.5 a$
		In any case, maximum dimension for elongated cavities, worm holes	2mm
		Short imperfections for	
		-butt welds	$h \leq 0.5 s$
		-fillet welds	$h \leq 0.5 a$
		In any case, maximum dimension for elongated cavities, worm holes	4mm or Not Larger Than Thickness (NLTT)
8.	Solid inclusions (other than copper)	Long imperfections for	
		-butt welds	$h \leq 0.5 s$
		-fillet welds	$h \leq 0.5 a$
		In any case, maximum dimension for elongated cavities, worm holes	2mm
		Short imperfections for	
		-butt welds	$h \leq 0.5 s$
		-fillet welds	$h \leq 0.5 a$
		In any case, maximum dimension for elongated cavities, worm holes	4mm or Not Larger Than Thickness (NLTT)
9.	Lack of fusion (incomplete fusion)		Permitted, but only intermittently and not breaking the surfaces

10. Bad fit-up,
fillet weld



An excessive or insufficient gap between the parts to be joined.
Gaps exceeding the appropriate limit may in cases be
compensated for by a corresponding increase in the throat.

$h \leq 1\text{mm} + 0.3 a$
max. 4mm

WELDING DETAILS		Limits for Imperfection with reference to quality level: DIN EN 25817 / D
Sl No	Imperfection Designation	
	Outside status	
11.	Incomplete penetration	 <p>Long imperfections: Not permitted Short imperfections: $h \leq 0.2 s$, max. 2mm</p>
12.	Cracks	All types of cracks Not Permitted
13.	Crater cracks	Permitted
14.	Spatters	Fused welding splashes are material trickless (drops) fused to the basic material or welding seam. Permissible
15.	Stray flash or arc strike	Ignition points are local fuses caused by the electric arc on the surface of the basic material or welding seam. Permissible

Abbreviations

- a nominal fillet weld throat thickness (fillet thickness), in mm
- b width of weld reinforcement, in mm
- d pore diameter in mm
- h size (height or width) of imperfection, in mm
- l length of imperfection, in mm
- s nominal butt weld thickness or, in the case of partial penetration, the prescribed depth of penetration, in mm
- t tube-wall- or plate thickness, in mm
- z leg length of fillet welds (in case of isoscele-right angle triangular section $z = a \cdot \sqrt{2}$) in mm

ANNEXURE-2

CORROSION PROTECTION PAINTING

REQUIREMENTS

1. Painting of steel parts

All steel parts must be coated immediately after shot blasting according to EN-ISO 12944-4. Surface must be free of fat.

- a. Material:
 - M/s Southfield paints –RAL 6011 Green or equivalent
 - M/s Toyo paints – RAL 1000 Black or equivalent
 - M/s Akzo Nabal Coatings India Pvt. Ltd. – RAL 1004 Yellow colour or equivalent
- b. Execution:
 - Painting is performed as given below:
 - Layer thickness:
 - Standard:
One layer coating thickness of minimum 100 microns.
 - Long term protection:
Two layers coating to total thickness of minimum 180 microns.
- c. Mixing of paint compounds:
 - The compounds (mother paint, accelerator, thinner) must be mixed according to instructions of the paint manufacture. The mixing procedure has to be adjusted to the ambient climatic situation.
- d. Coating:
 - Coating is performed with spray gun. Baking temperature 80 °C. furnace exposing time 45 minutes.
- e. Coating thickness control:
 - Measurements to be taken at 5 random points. Acceptable thickness is 10% below specified thickness.

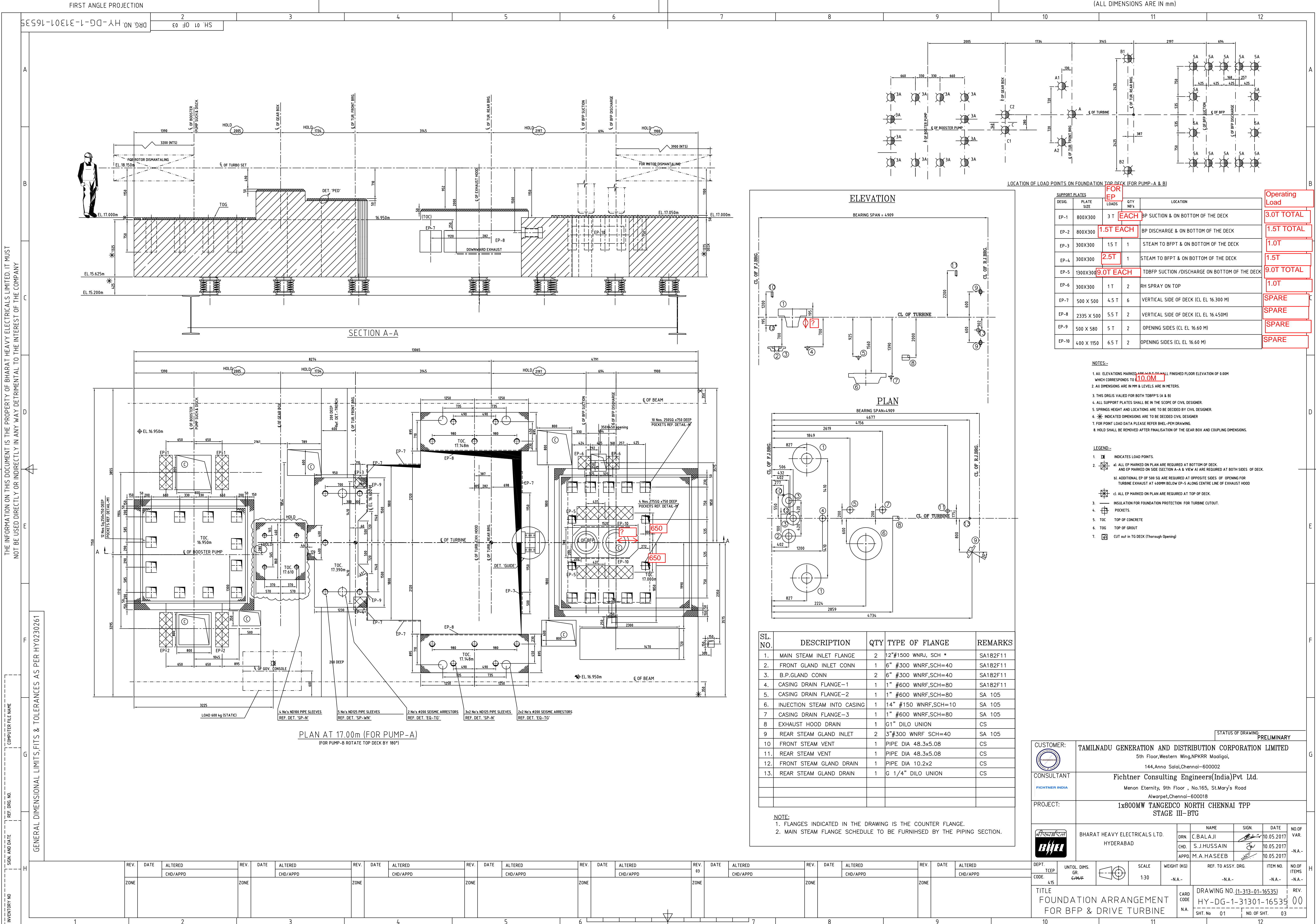
2. Springs

All the springs must be powder coated by "Electrostatic powder coating spray process" (EPS).

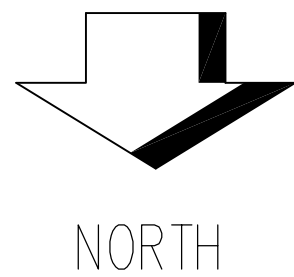
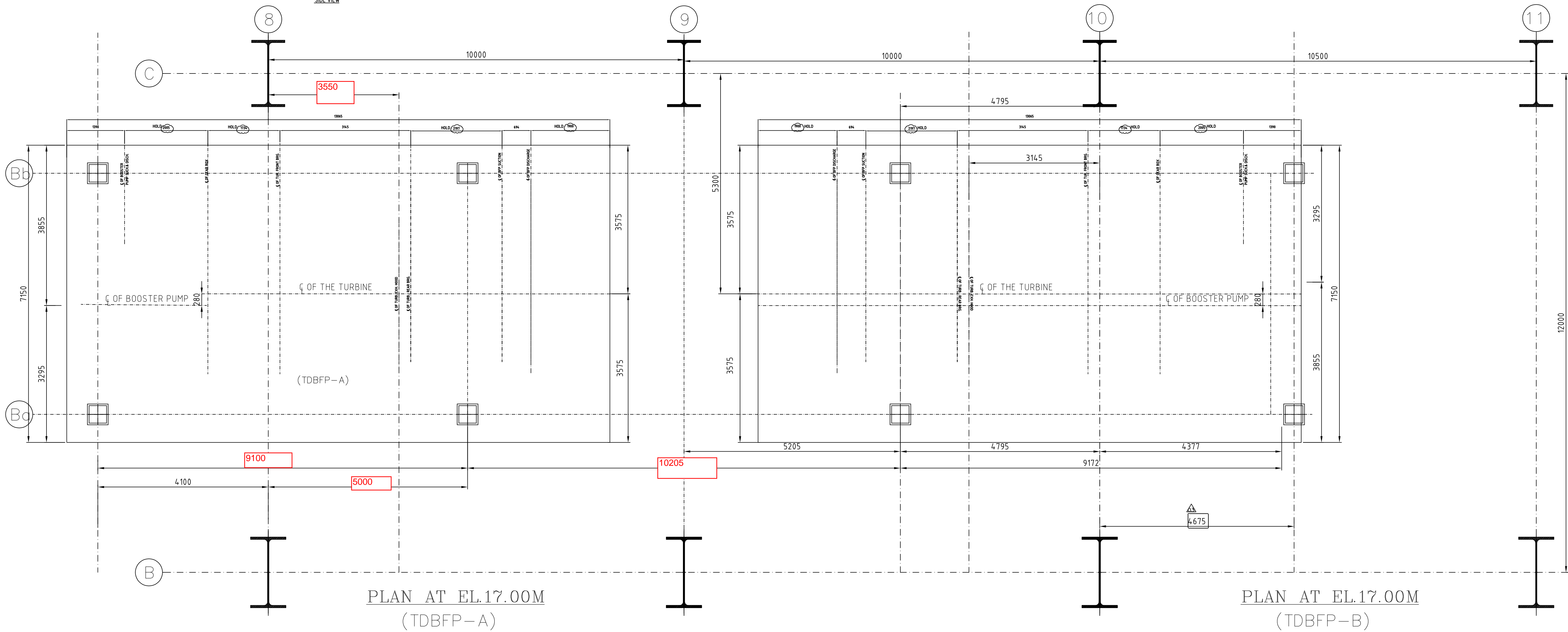
- a. Preparation:
 - Springs must be oil free
- b. Execution:
 - Electrostatic spray coating with an epoxy polyester powder. Baking temperature 190 °C +10 °C. furnace exposing time of 40 minutes.
 - Colour: Black.
- c. Coating thickness:
 - Coating thickness must be minimum of 70 microns.

Note.

1. The colour of paint is subjected to as per customer requirement.



GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261

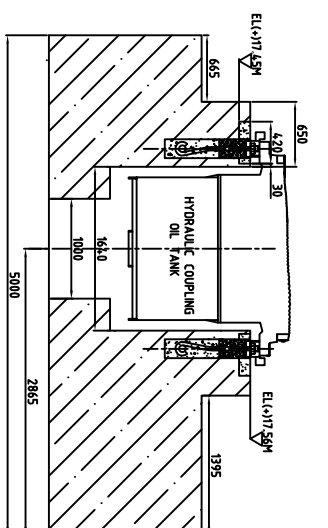


REF. DRGS.: —

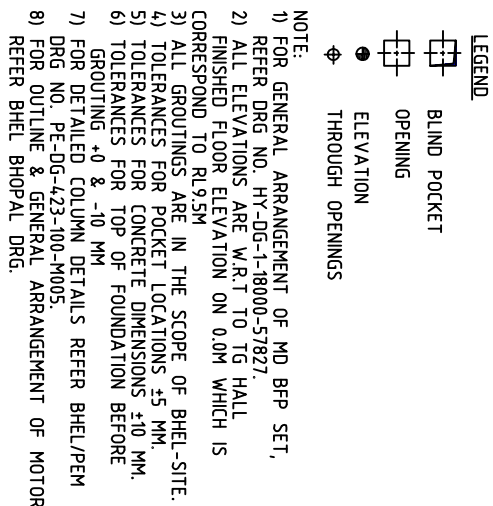
S.No.	BHEL DRG.No.	TITLE
1	PE-DG-423-100-M005	TG EQUIPMENT PLAN AT EL.17.0 m.

[illegible]

CUSTOMER:		TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED 5th Floor, Western Wing, NPKRR Madilgai, 144, Anna Salai, Chennai-600002									
CONSULTANT		Fichtner Consulting Engineers(India) Pvt Ltd. Menon Eternity, 9th Floor - No.165, St.Mary's Road Alwarpet, Chennai-600018									
PROJECT:		1x800MW TANGEDCO NORTH CHENNAI TPP STAGE III-BTG									
		BHARAT HEAVY ELECTRICALS LTD.									
		HYDERABAD									
				NAME		SIGN		DATE		NO OF VAR.	
		DRN.		C.B.ALAJI				10.05.2017			
		CHD.		S.J.HUSSAIN				10.05.2017		-NA-	
		APPO		M.A.HASEEB				10.05.2017			
DEPT. / STEP		UNTOL DIMS GR.		SCALE		WEIGHT (KG)		REF. TO ASSY. DRG.		ITEM NO.	
CODE: 415		CAMP		1:30		-NA-		-NA-		-NA-	
TITLE											
FOUNDATION ARRANGEMENT											
FOR BFP & DRIVE TURBINE											
CARD CODE								DRAWING NO. (1-313-01-16535)		REV.	
NA.								HY-DG-1-31301-16535		00	
								SHT. NO 02		NO OF SHT. 03	



SECTION I-1



- 1) NOTE:
 - 1) FOR GENERAL ARRANGEMENT OF MD. BFP SET, REFER DRG. NO. HY-JDG-1-18000-5/7827.
 - 2) ALL ELEVATIONS ARE W.R.T TO TIG HALL FINISHED FLOOR ELEVATION ON 0.0M WHICH IS CORRESPOND TO RL9.5M
 - 3) ALL GROUPINGS ARE IN THE SCOPE OF BHEL-SITE.
 - 4) TOLERANCES FOR POCKET LOCATIONS ± 5 MM.
 - 5) TOLERANCES FOR CONCRETE DIMENSIONS ± 10 MM.
 - 6) TOLERANCES FOR TOP OF FOUNDATION BEFORE GROUTING $+0$ & -10 MM
 - 7) FOR DETAILED COLUMN DETAILS REFER BHEL/PEM DRG NO. PE-JDG-4-23-100-0005.
 - 8) FOR OUTLINE & GENERAL ARRANGEMENT OF MOTOR REFER BHEL BHOPAL DRG.

COMP. FILE NAME
FP118000057825-0

⑤





⑥

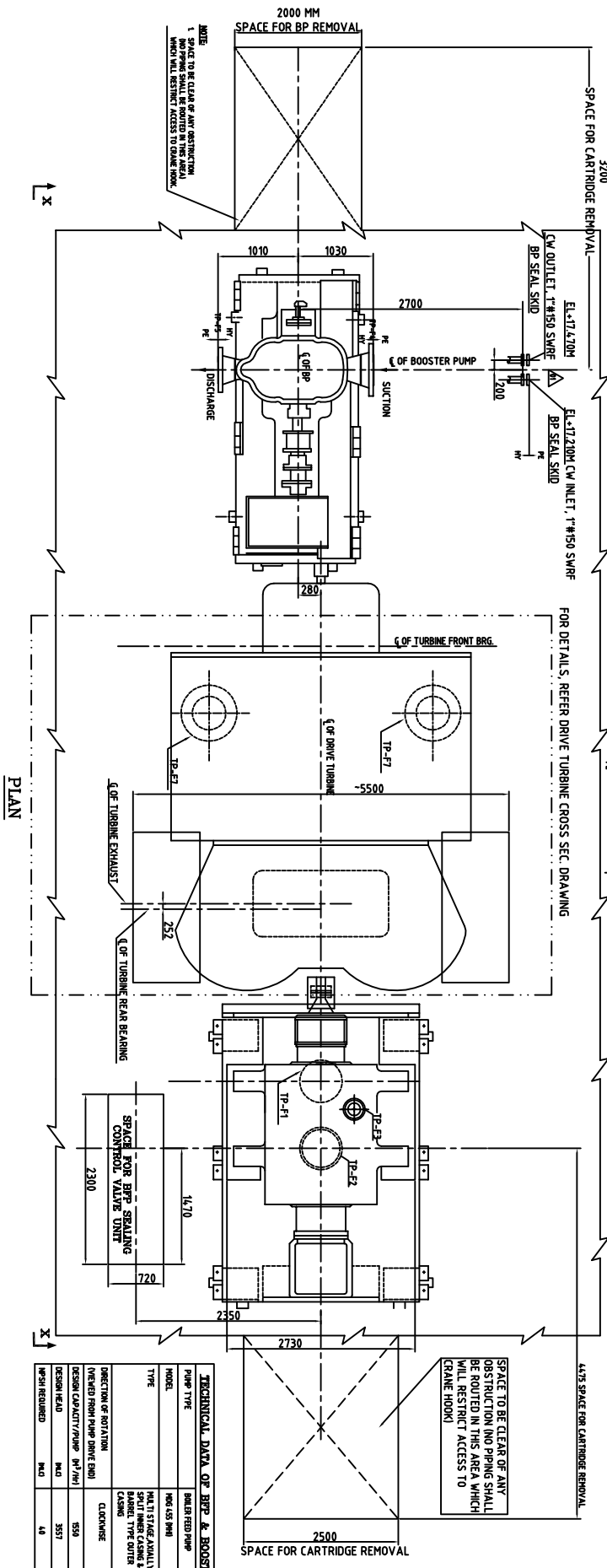
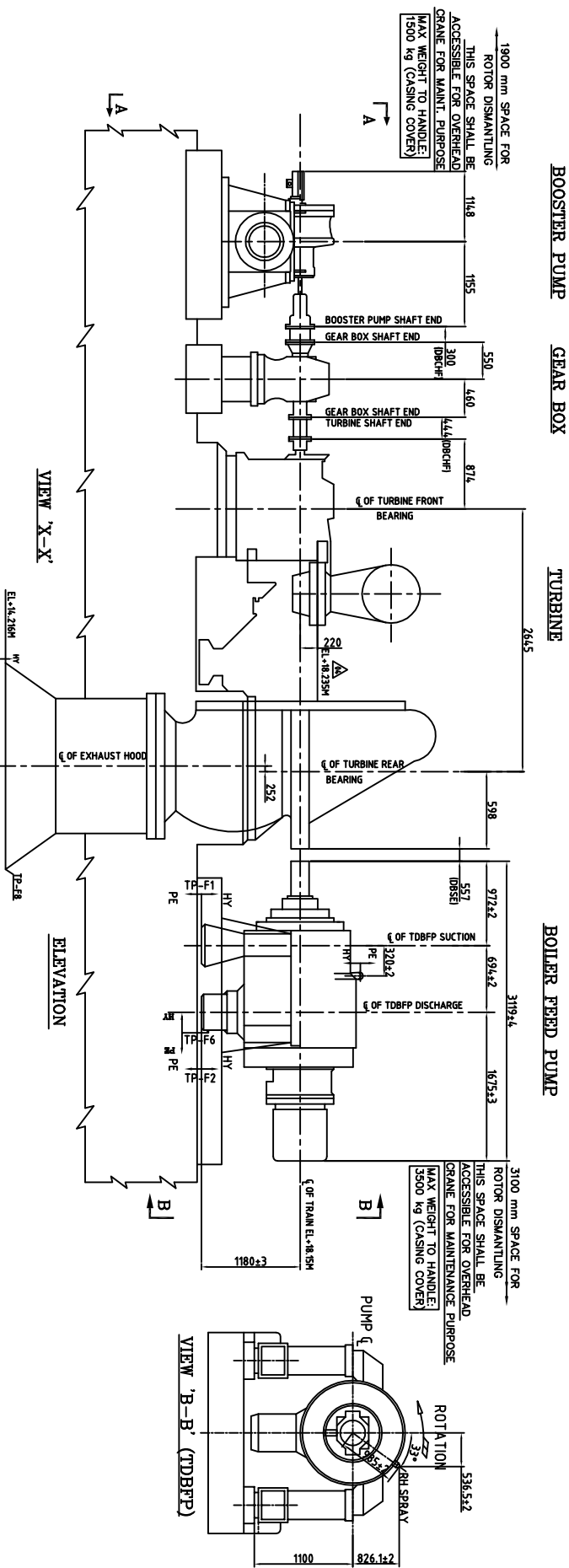
⑦

⑧

PLAN (BEFORE GROUTING)

CUSTOMER	TAMAMU CORPORATION AND DISTRIBUTION CORPORATION LIMITED <small>2th Floor, Nakano Bldg., 1-1-1, Nakano, Tokyo</small>
JOB NO.	<small>14-Kansai Steel/Concrete-000002</small> USJ 00th <small>Produce Consulting Engineer (Ltd.) P/Ltd.</small> <small>Member Company, 9th Floor, 1-1-1, Nakano, Tokyo</small>
PROJECT	14000W TANABUCHI NORTH CHANNEL TYP STAGE III - FRT
DESIGNED BY	SHIBATA HEAVY ELECTRICALS LTD <small>HYDERABAD</small>

	CLIENTS	TAMARINDO GENERATION AND DISTRIBUTION CORPORATION LIMITED 26 Pinar del Mar, Mayaguez, P.R. 00851 144 Ave. Soto/Casas-00002
	CONSULTERS	Poshair Consulting Engineers/Architects, P.C. Bosch Building, 100 Ave. North, Suite 307, Miami Stable 10-370
	PROJECT	15000V TAMARINDO NORTH CANNAL TFS
	PROJECT	BHAMAT HEAVY ELECTRICALS LTD HYDROCAD



TERMINAL POINT	DESCRIPTION	SIZE INCHES	TERMINATED WITH	QTY
TP-F1	SUCTION OF FEED PUMP	16	400 x BW	1
TP-F2	DISCHARGE OF FEED PUMP	18	450A BW	1
TP-F3	RAISPRAY	3	ASME 500LB-40A R1	1
TP-F4	SUCTION OF BOOSTER PUMP	18	ASME 600LB-450A	1
TP-F5	DISCHARGE OF BOOSTER PUMP	18	ASME 600LB-500A	1
TP-F6	WARGING INLET CONNECTION	15	40ASB	1
TP-F8	TURBINE INLET STEAM INLET	10	1500MM SCH40CS	2
TP-F8	TURBINE EXHAUST MHOOD	DA 2032346		1

STATIC & DYNAMIC LOADS FOR BP & BFP	
STATIC LOAD (kg)	BOOSTER PUMP
VERTICAL	34900
VERTICAL	8950
HORIZONTAL	40950
AXIAL	27300

ITEM	BOLLER FEED PUMP		BOOSTER PUMP	
	DRY (kg)	WET (kg)	DRY (kg)	WET (kg)
PUMP	27000	27300	5400	5900
BASE	7600	7600	3100	3100
TOTAL	34600	34900	8500	9000

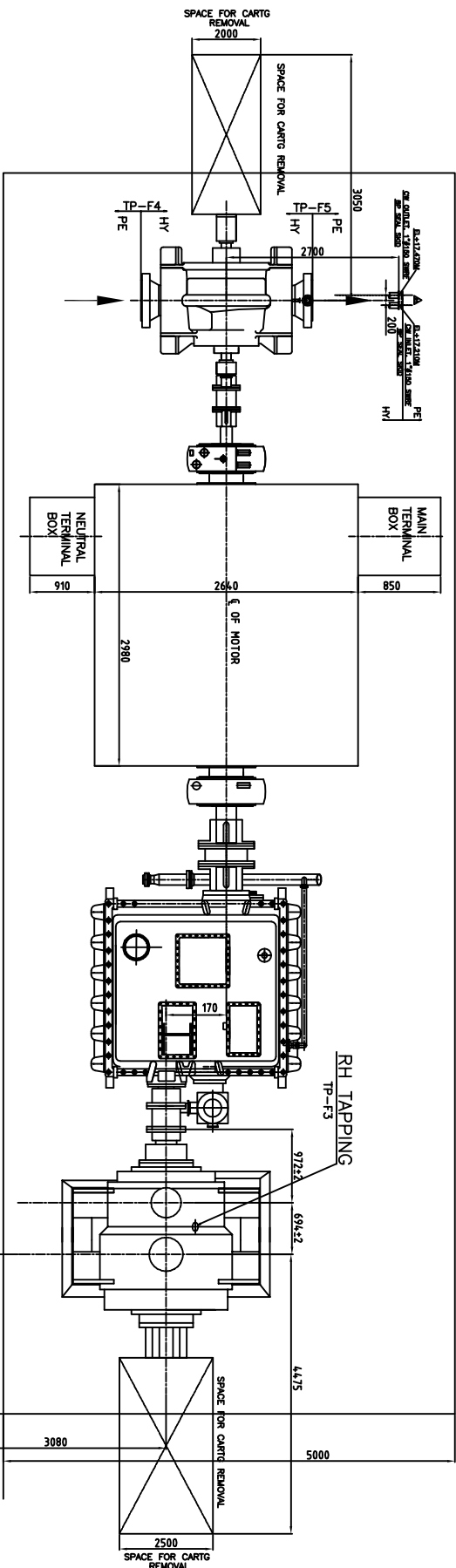
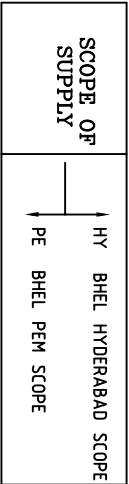
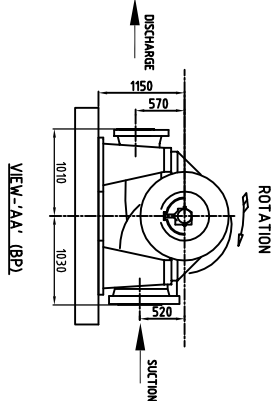
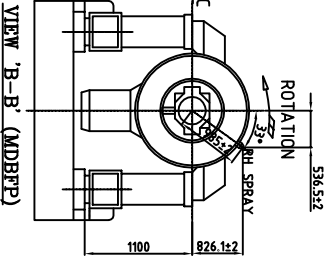
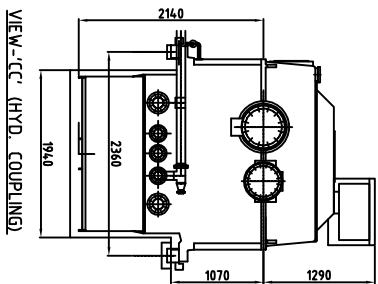
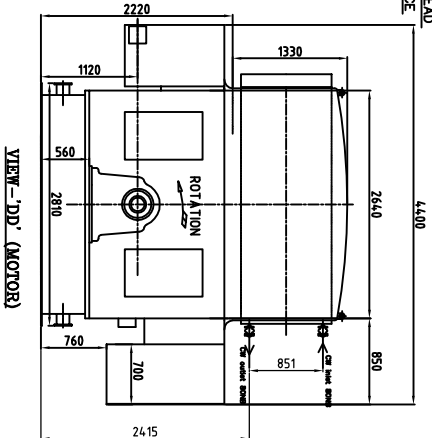
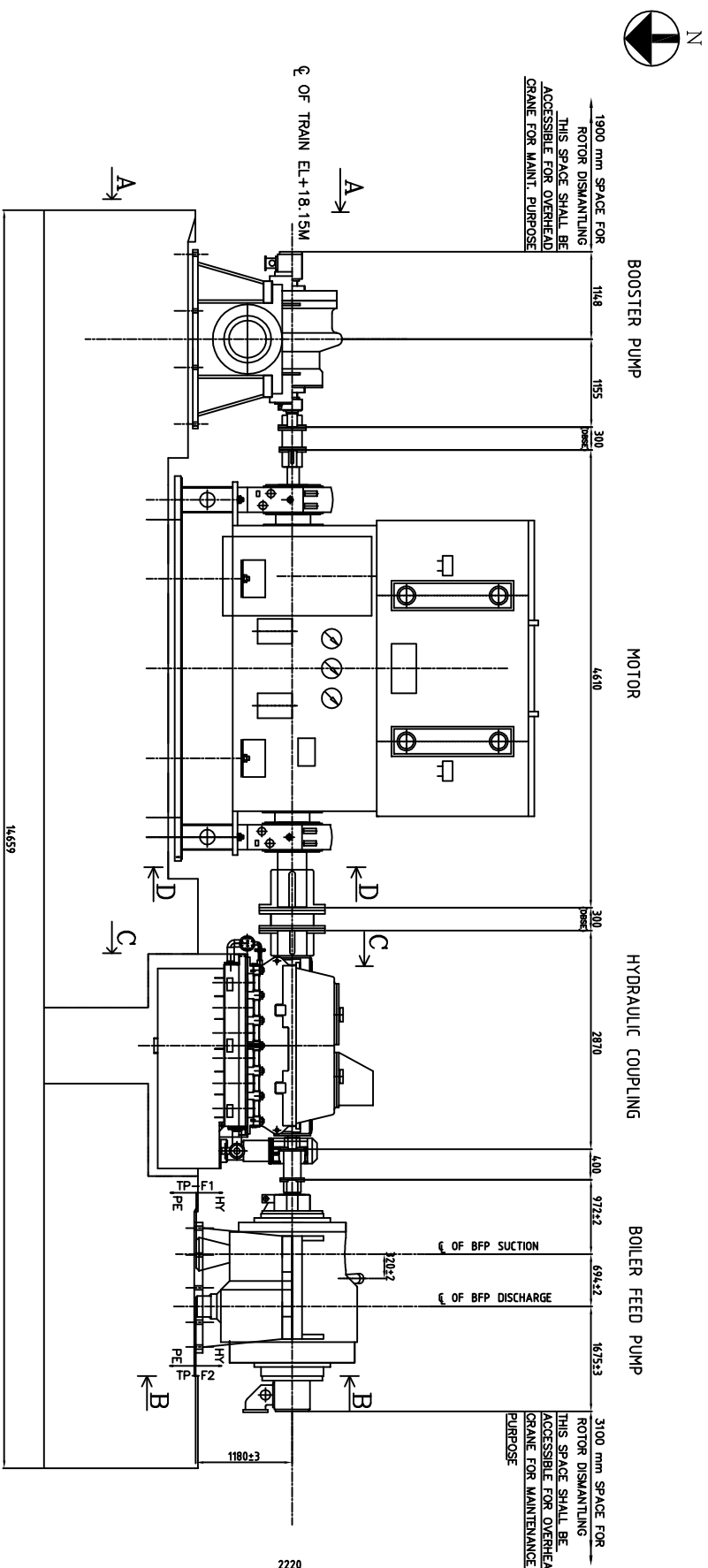
ITEM	WEIGHT
DRIVE TURBINE	61000
GEAR BOX TOTAL WT	1300
GEAR BOX HIGH SPEED SHAFT	200
GEAR BOX LOW SPEED SHAFT	500

NOTE:

1. TERMINAL POINTS SHOWN IN THE PLY. SCOPES INCLUDES COUNTER FLANGES ALONG WITH FASTENERS & GASKETS.
2. REFER TDRP- SET FOUND. DRG. HY-DG-6-310H-4635 FOR THE FOLLOWING:
 - i) LOADING POINTS & LOADING DETAILS
 - ii) TUBING DETAILS AND ELEVATION OF TUBING AND PIPES
3. FOR OT LUBE OIL EQUIPMENT LAYOUT REFER DRG. NO. HY-DG-6-310H-4635
4. THIS DRG IS VALID FOR TDRP-44-TDRP-48
5. ALL ELEVATIONS ARE WITH RESPECT TO EL+0.00 m, FINISHED GROUND FLOOR LEVEL OF TG BUILDING (WHEN CORRESPONDING TO EL+0.55 m).
6. REFER GA. OF TUBING OIL COOLER DRG NGHY-DG-3-4635-34401 FOR INTERFACE DETAILS.

1.	JOB NO :	423
2.	STATUS:	CONTRACT
3.	DRG./REF. NO. (INTERNAL)	1 180 005 7826
4.	DISTRIBUTION	
5.	TO	
6.	No. OF	

[illegible]



PLAN

TERMINAL POINTS

TERMINAL POINT	DESCRIPTION	SIZE (INCH)	TERMINATED WITH	QTY.
TP-F1	SUCTION OF FEED PUMP	16	400A (B.W.)	1
TP-F2	DISCHARGE OF FEED PUMP	18	400A (B.W.)	1
TP-F3	R.H. SPRAY	3	ASME 1500 LB-100A R.L.	1
TP-F4	SUCTION OF BOOSTER PUMP	18	ASME 600LB-450A	1
TP-F5	DISCHARGE OF BOOSTER PUMP	14	ASME 600LB-350A	1

TECHNICAL DATA OF BOILER FEED PUMP & BOOSTER PUMP			
PUMP TYPE	BOILER FEED PUMP	BOOSTER PUMP	
MODEL	H06 436 (H40)	HLC 450/353 H (H40)	
TYPE	MULTI STAGE AXIALLY SPLIT INNER CASING & BARREL TYPE OUTER CASING	SINGLE STAGE RADIALY SPLIT TYPE	
DIRECTION OF ROTATION (VIEWED FROM PUMP DRIVE END)	CLOCKWISE	COUNTER CLOCKWISE	
DESIGN CAPACITY/PUMP (m ³ /hr)	1550	1550	
DESIGN HEAD (M.C)	3557	238	
WPSH REQUIRED (M.C)	40.0	8.2	
MOTOR RATING OF BFP SET (KW)	20,500		

- NOTE :
1. TERMINAL POINTS SHOWN IN THE HYD. SCOPE INCLUDES COUNTER FLANGES ALONG WITH FASTENERS & GASKETS.
 2. FOR LOADING POINTS & LOADS, REFER MDBFP FOUND. DRG.NO.: HY-DG-1-18000-57825
 3. ALL ELEVATIONS ARE WITH RESPECT TO TG HALL FINISHED FLOOR ELEVATION OF 0.0M WHICH CORRESPONDS TO R.L. (+)9.5 M.

INVENTORY NO	SIGN. AND DATE	COMP. FILE NAME	THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY															
		FP11800057827-00																
REV.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.	DATE	APPRO.
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16																		

1. JOB NO. : 423	2. STATUS : CONTRACT	3. DRG./REF. NO. INTERNAL : 1 180 005 7827	4. DISTRIBUTION	5. TO	6. No. OF
TITLE : GENERAL ARRANGEMENT OF MDBFP SET					
CUSTOMER : TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED					
DESIGNER : Bhaskar Consulting Engineers (P) Ltd.					
PROJECT : ISROHAR SHARER II-303					
BHEARAT HEAVY ELECTRICALS LTD					
HYDERABAD					
DRAWING NO. HY-DG-1-18000-57827					
SHEET 1 OF 02					

8	6	
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PROPOSED TRENCH COVER

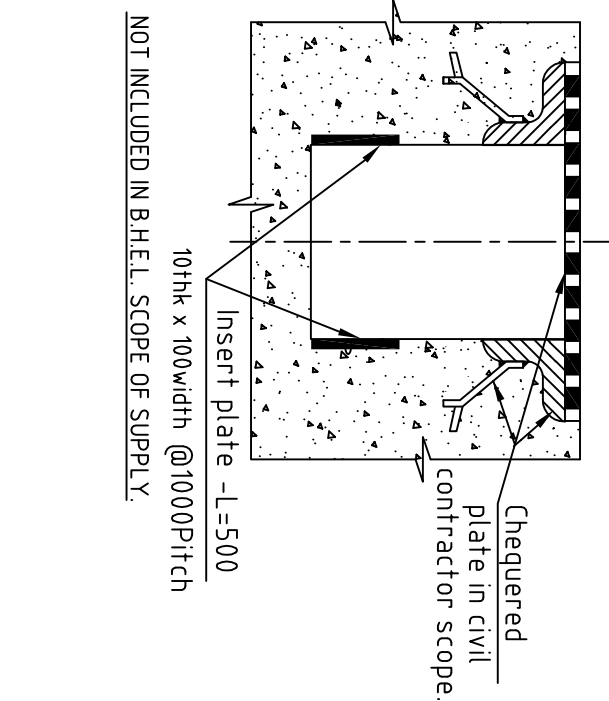
Insert plate - L=500

10th x 10th width @ 1000 Pitch

Chequered plate in civil contractor's scope

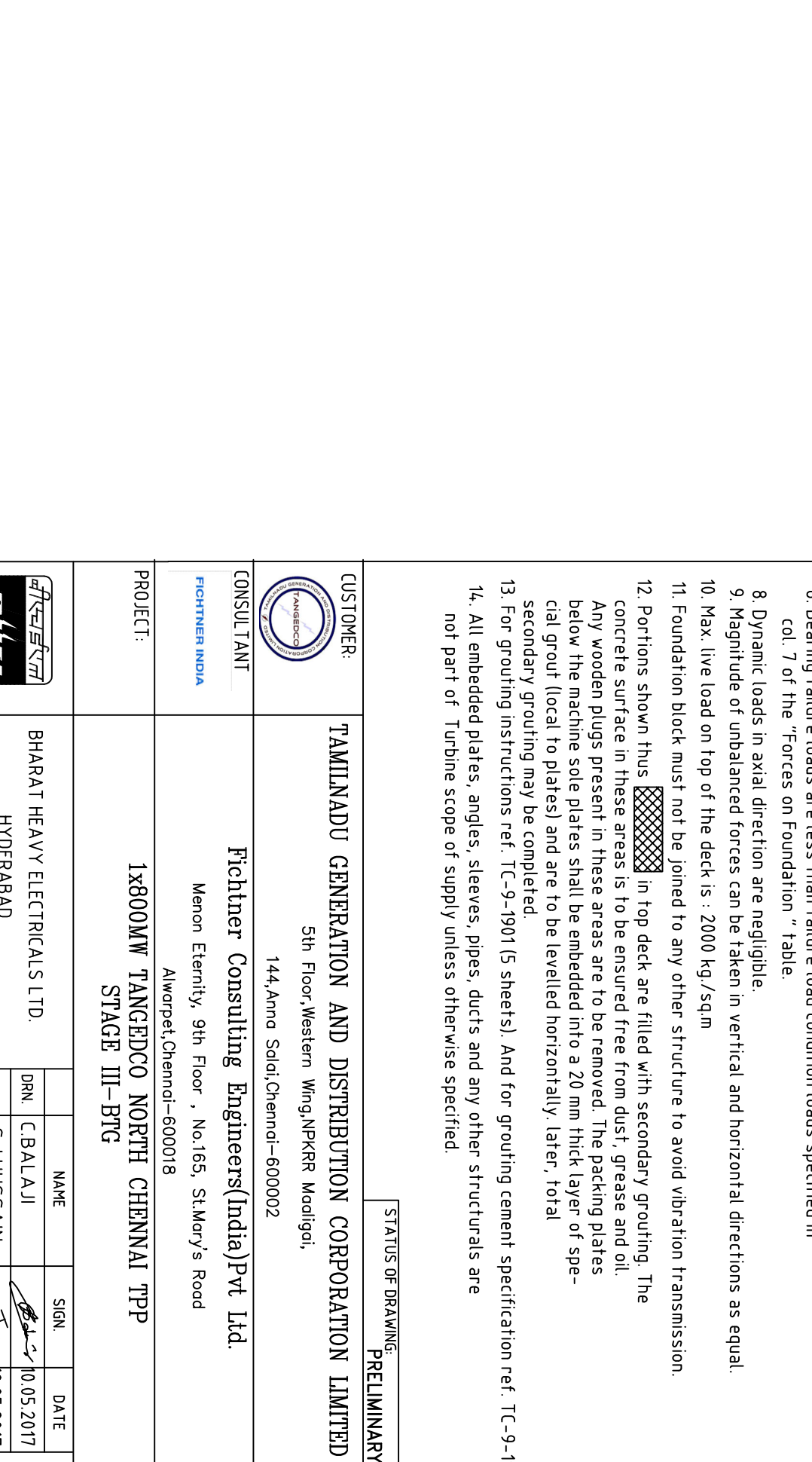
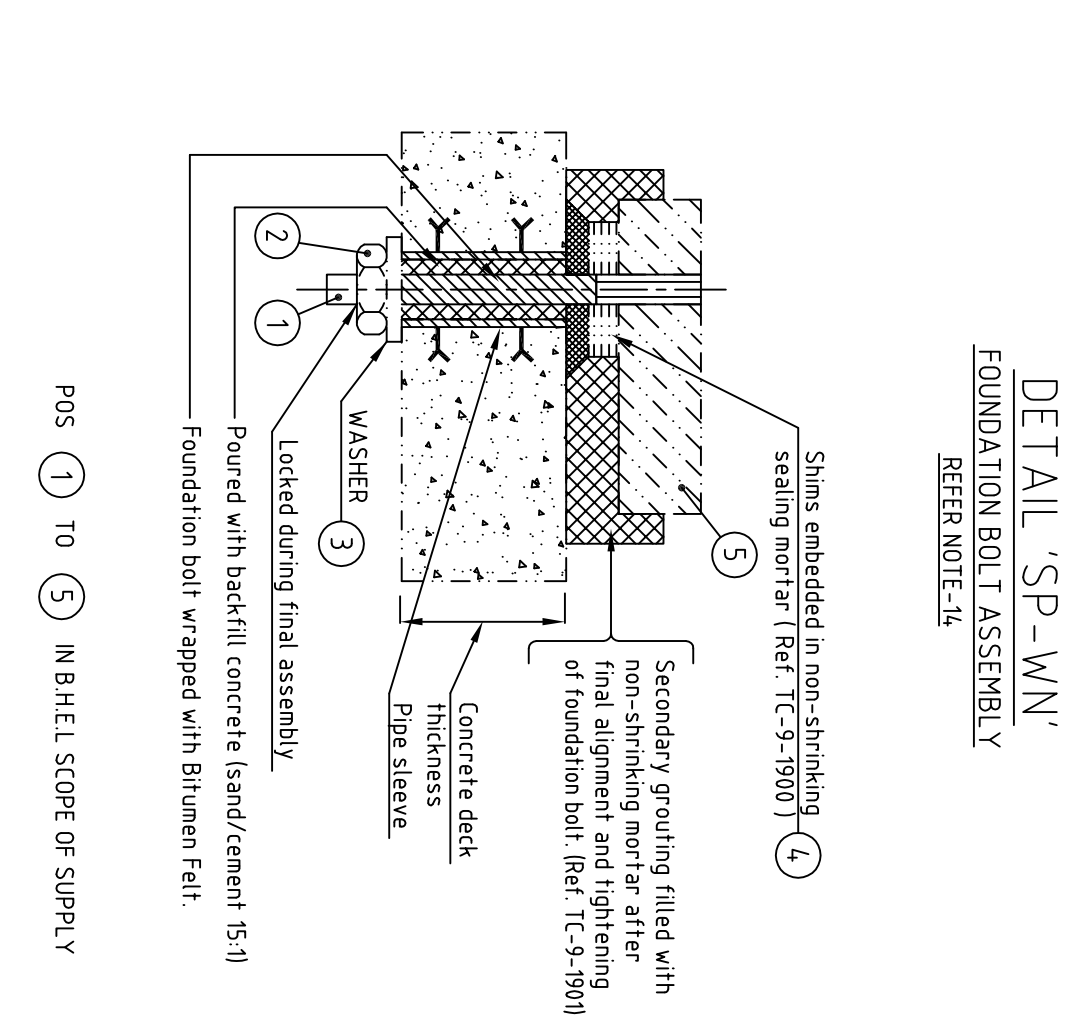
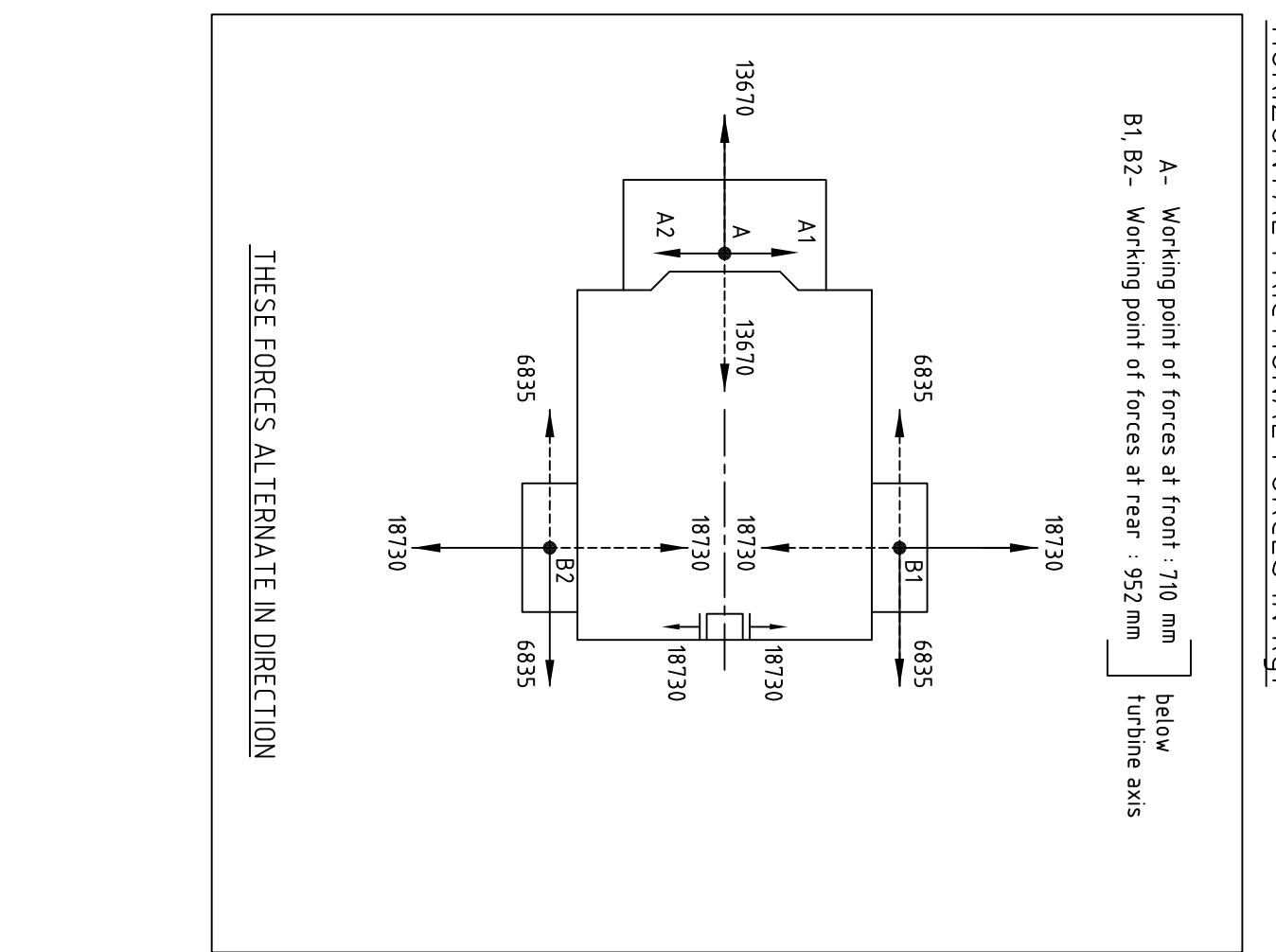
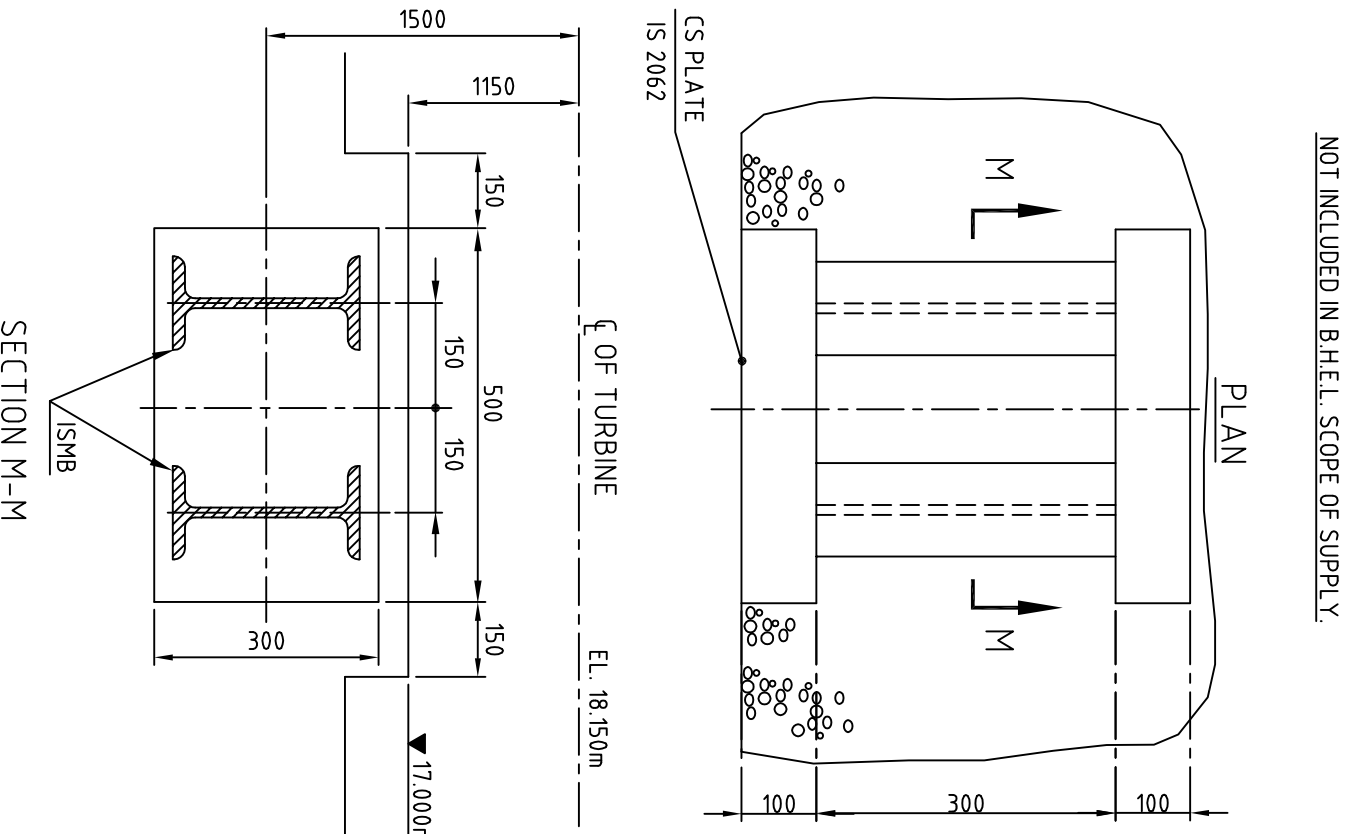
NOT INCLUDED IN B/E/L, SCOPE OF SUPPLY


FORCES ON FOUNDATION IN kgf	
WEIGHT WITHOUT	
WEIGHT	
WEIGHT OF /VACUUM	
UIT LOAD *	
0 TORQUE	
UNBALANCE ** (ROTATING)	
DE LOAD ** e breakage	



1	-	STATIC LOAD WITHOUT ROTATING WEIGHT
2	4050	ROTATING WEIGHT
3	700	OPERATING WEIGHT OF CONDENSER/VACUUM PULL
4	-	SHORT CIRCUIT LOAD *
5	104.0	LOAD DUE TO OPERATING TORQUE
6	14.0	OPERATING UNBALANCE DYN. LOAD (ROTATING) *
7	864.0	FAILURE MODE LOAD ** (Turbine : Blade breakage

FORCES ON FOUNDATION IN kgf						
1	2	3	4	5	6	7
STATIC LOAD WITHOUT ROTATING WEIGHT	ROTATING WEIGHT	OPERATING WEIGHT OF CONDENSER/VACUUM PULL	SHORT CIRCUIT LOAD *	LOAD DUE TO OPERATING TORQUE	OPERATING UNBALANCE DYN. LOAD (ROTATING) **	FAILURE MODE LOAD ** (Turbine - Blade breakage)
-	4050	-	-	-	14,0	864,0
1364,0	-	700	-	104,0	-	-
1364,0	-	700	-	-104,0	-	-
-	-	-	-	-	-	-
2136,0	24,75	19100	-	-310	880	5280
2136,0	24,75	19100	-	310	880	5280
660	-	-	-	-	-	-
-	220	-	-	3600	80	480
-	550	-	-	-3600	60	360



DEPT.	UNIT OR DIMS	SCALE	WEIGHT (KG)	REF. TO ASSY DRWG	ITEM NO.
TYPE	<i>CFM4</i>		N.T.S.	N.A.	N.A.
CODE	15				
TITLE					
FOUNDATION ARRANGEMENT					
FOR BFP & DRIVE TURBINE					
CARD	DRAWING NO. (1-313-01-16535)				
	HY-DG - 13101-16535				
SHT. NO.	03	NO. OF SHT.		03	

PRE - QUALIFYING
REQUIREMENTS

DOCUMENT NO: PE-TS-423-614-C002

REVISION NO: 0 DATE: 11-08-2017

SHEET: 1 of 1

ENQUIRY NO: , Dated:

PROJECT: 1X800 MW TANGEDCO NORTH CHENNAI TPP STAGE-III**PACKAGE: VIBRATION ISOLATION SYSTEM (VIS) FOR TD BFP & MD BFP FOUNDATION****CRITERIA FOR EVALUATION (TECHNICAL / FINANCIAL):**

- a. Vendor should have **supplied and commissioned VIS** for Turbine Driven (TD) & Motor Driven Boiler Feed Pump (BFP) foundation or similar machine foundation in power plants (minimum 200 MW rating) and furnish experience list of at least two recently executed contracts where such systems have been successfully installed for such applications. 2 (two) nos. purchase orders shall be submitted which should not be more than 10 (ten) years old as on date of bid submission for establishing continuity in business. The vibration isolation system shall be of proven make and should be in successful operation for such foundation for at least one year.
- b. The vendor should have at least two year **design experience** in design of VIS module, selection and finalization of Layout of VIS as well as design of RCC deck slab resting on VIS and supporting the machine and be able to furnish static and dynamic analysis of the same. Calculation should establish that not more than 10% dynamic loads are transferred to the structure supporting the VIS and that the foundation system meets the amplitude and frequency requirement as required by the machine manufacturer. The isolation system and R.C.C. deck slab shall be able to withstand seismic loading in addition to other loadings i.e. dead, live, wind, dynamic etc. Seismic design shall conform to IS: 1893 (Criteria for Earthquake Resistant Design of Structures) or equivalent international standard. The vendor should furnish supporting documents for the same.
- c. **Performance certificate** (along with copy of relevant purchase order) from the end user/customer for at least two (different Customers) successfully executed contracts which are in successful operation for at least one year for the applying package shall be furnished.

OR

The supplier has been awarded **Repeat Purchase order** from same customer (placed with minimum gap of 1 (one) year after commissioning of machine supported on VIS of previous contract). Repeat purchase orders shall be furnished from two different customers.

In case supplier is not OEM, offer shall be evaluated as per point 1. of Notes to PQR available at <http://bhelpem.com/vensection/PMD/PMD.aspx>

PREPARED BY:

NAME: Pankaj Kumar
DESIGNATION: Sr. Engineer
DEPT.: Civil

REVIEWED BY:

NAME: Sushil Kr. Mahato
DESIGNATION: Manager
DEPT.: Civil

APPROVED BY:

NAME: Tarun Kr. Mehta
DESIGNATION: Sr.DGM
DEPT.: Civil