CLAUSE NO.	TECHNICAL REQUIREMENTS
	e) For pipe with pre-fabricated tape, the test voltage which the pipe should pass with holiday detector kit at voltage 15 kV for 4 mm thickness coating.
5.06.03	Measuring Coating Thickness a) All pipes shall be tested for thickness as per AWWA-C-203-97. b) The thickness shall be measured by pushing the point of an approved pit depth gauge or microtester through the coating and wrappers. c) The specified minimum thickness shall be present both at the pipe or any other point.
5.06.04	Testing the adhesion of the coating a) At least two tests a day shall be carried out on finished coating after 72 hours from completion of coating. The test shall be carried out as per AWWA-C-203-97 /IS 10221. b) The areas where the coating has been removed for testing by the inspector shall be repaired by the Contractor at his own expense.

09438

SUB-SECTION – E-129

LOW PRESSURE PIPING

CLAUSE NO.	QUALITY ASSURANCE

LOW PRESSURE PIPING SYSTEM
LOW PRESSURE PIPING :

Items / Components (Tests/Check →)	Material Test	DPT/MPI	Ultrasonic Test	WPS/ WQS/PQR	Balancing	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Performance Test	Other Tests	All Tests as per relevant Std	Adhesion/Spark Tests	REMARKS
1. Pipes & Fittings and Metered Bends	Y[a]	Y[b]		Y		Y			y			Y[15]			
2. Diaphragm Valves	Y[a]					Y[5]			Y				Y[6]		
3. Butterfly Valves(Low Pressure)															
3.a) Casted Butterfly Valves						Y		Y	Y	Y		Y7			
(i)Body (Cast)	Y[a]	Y[b]													
(ii)Disc (Cast)	Y[a]	Y[b]													
(iii)Shaft	Y[a]	Y	Y[c]												
3.b) Fabricated Butterfly Valves															REF. NOTE 14
4. Gate/ Globe/Swing Check Valves	Y[a]	Y[b]	Y[c]			Y[5]	Y	Y	Y	Y		Y[8]			
5. Dual Plate Check Valves	Y[a]	Y[b]	Y[c]			Y	Y	Y	Y	Y		Y[4]			
6. Rolled & Welded Pipes	Y[a]	Y[3]		Y		Y[1]			Y						
7. Coating & Wrapping of Pipes	Y[2]											Y[2]			
8. Tanks & Vessels	Y[a]	Y[b]		Y		Y									
9. Strainers	Y[a]	Y[b]				Y						Y[11]			
10. Rubber Expansion Joints	Y[a]					Y[12]		Y				Y[13]			
11. Rubber Lining of Pipes	Y[a]	X		X		Y			Y				Y[9]	Y	
12. Hangers & Supports	Y[a]								Y						
13. Fastners	Y[a]		X				X								
14. Site Welding		Y[10]		Y		Y									

09440

CLAUSE NO.	QUALITY ASSURANCE

Notes:

1. Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.
2. Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91
3. DPT on route run and after back gouging and on finish welds.
4. Dry Cycle Test (Dual Plate Check valve) for one lakh Cycles shall be carried out as a type test.
5. Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.
6. Tests on rubber parts per batch of rubber mix such as hardness, adhesion, spark test, bleed test and flex test on diaphragm, type test for diaphragm for 50,000 cycles.
7. Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with latest edition of AWWA-C-504 in presence of owner's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. Seat Leakage Test shall be carried out in both directions.
8. Blue matching, wear travel for gates, valves, pneumatic seat leakage, reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes
9. (i) Hardness, Bleeding Test and Ozone resistance test shall be done on rubber material

   (ii) Dry film thickness check, humidity check, pipe temperature check, adhesion check and Holiday Detection test shall be done.
10. 10% of welds shall be subjected to DPT.(100% DPT for compressed air line and boiler & deaerator fill line.)
11. Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review and acceptance by NTPC Engineering.
12. During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.
13. Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.
14. In addition of all tests as indicated for Cast Butter Fly valve being applicable for fabricated butterfly valves, following test shall be done for fabricated butter fly valve:
    - UT as per ASTM A-435 on plate material for body and disc shall be carried out for plate thickness 20mm and above.
    - 100% RT and DPT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc. 10% DPT on other welds shall be done.

CLAUSE NO.	QUALITY ASSURANCE

- Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc if thickness is more than 30mm.

[a] **One per heat/heat treatment batch/lot.**

[b] **On machined surfaces only for castings and on finished butt welds.**

[c] **For shaft/spindles > or = 50 mm**

15. **If applicable:** Segmented flange exceeding 30 mm thickness shall be stress relieved and not more than 4 segments is allowed. For stainless segmented flanges and stainless steel fabricated fitting, 100% radiography of all weld seams including mother pipe weld seam shall be employed.

16. **If applicable:** For pressure vessel welds RT shall be done as per design code requirements.

ANNEXURE – VII

SPARES

CLAUSE NO.	LIST OF MANDATORY SPARES
1.00.00	**GENERAL** The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and Recommended spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:
1.01.00	**MANDATORY SPARES** a) The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by *) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings. c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly. d) The Employer reserves the right to buy any or all the mandatory spare parts. e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. f) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments. g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.

CLAUSE NO.	LIST OF MANDATORY SPARES
1.02.00	**RECOMMENDED SPARES** a) In addition to the spare parts mentioned above, the Contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Forms & Price Schedules. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment. b) Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.
1.03.00	**START-UP & COMMISSIONING SPARES** a) Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Plant is handed over to the Employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.
1.04.00	The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules.The general requirements pertaining to the supply of these spares is given below:
2.00.00	The Contractor shall indicate the service expectancy period for the spare parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.
3.00.00	All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccator packs as necessary.
4.00.00	All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.

CLAUSE NO.	LIST OF MANDATORY SPARES
5.00.00	The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares.
6.00.00	Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
7.00.00	All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.
8.00.00	The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/equipments covered under the Contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
9.00.00	The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.
10.00.00	In addition to the recommended spares listed by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.
11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.

10115

Clause No.	LIST OF MANDATORY SPARES FOR SG & AUXILIARIES	
16.00.00	**Mill Reject Handling System**	
	A. Pneumatic Conveying System	
	1. Conveying System	
	(a) Pneumatic main valve	1 Set of each type
	(b) Pneumatic/Solenoid Two/Three position control valve	1 Set of each type
	(c) Plate/Dome valve with actuators (including seals)	1 Nos.
	(d) Plate/Dome valve seals	1 Set
	B. Compressor(Reciprocating type, if applicable	
	(a) Compressor	1 No. of each

Clause No.	LIST OF MANDATORY SPARES FOR SG & AUXILIARIES	
	7 Separator Level Monitoring Systems (if applicable)	20% or 2 Nos. of each type of component whichever is more.
	8 Conductivity type level monitoring system	
	(i) Electrodes	10% of population or 1 No. of each type and length whichever is more.
	(ii) Electronic Cards	20% or 2 Nos. of each typeand model whichever is more.
	(iii) Lamps/LEDs of display units	100%
	9 Electronic remote drum level monitoring system (in case of drum type boilers)	
	(i) Electrodes	50% of population.
	(ii) Electronic Cards	20% or 2 Nos. of each type and model whichever is more.
	(iii) Lamps/LEDs of display units	100%
	10 Mill and Air heater Fire detection system.	
	(a) Thermocouple	10%
	(b) Process actuator switches	10% or 1 No. whichever is more.
	11 Acoustic Steam Leak Detection System	
	(i) Singlr Processor and interface modules	10% or 2 Nos. of each type and model whichever is more
	(ii) Sensors and Transceivers	20% or 2 Nos. of each type and model whichever is more.
6.00.00	**MEASURING INSTRUMENTS** (For all systems including Auxiliary Boiler, Air Compressor, HP Dosing, ECW System)	
	1 Electronic Transmitters	
	(i) Transmitters of all types, ranges and model no. (for the measure-ment of Pressure, differential pressure flow, level, etc.)	10% or 1 No. of each type and model, whichever is more

Clause No.	LIST OF MANDATORY SPARES FOR SG & AUXILIARIES	
	2 Temperature elements	
	(i) RTD's* of each type and length	10% or 2 Nos. of each type and length Which ever is more
	(ii) Thermocouples of each type like K-type, R-type, metal etc. and length *	10% or 2 Nos. of each type and length Which ever is more more
	(iii) Cold junction compensation boxes of each model	10% or 2 Nos. whichever is more
	(iv) Thermostatic units for each model of CJC box.	10% or 2 Nos. whichever is more
	(v) Thermowell for application like mill outlet temperature and SH/ RH/Eco/ true gas temp. in furnace	10% or 2 Nos. of each type and length Which ever is more
	(vi) Temperature transmitters	10% of each type and length whichever is more
	3 Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, model, type population)
	4 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	5% or 1 No. of each type and model whichever is more
	5 Electrical Metering Instruments Electrical meters including voltmeter , motor current ammeter,	5% or 1 No. of each model and type whichever is more.
	~~6 PD Type Flow Transmitters~~	~~5% or 1 Set of each type and model~~ whichever is more.
7.00.00	**POWER SUPPLY SYSTEM** 24 V DC power supply system	
	(i) Silicon controlled thyristors, diodes, power transistors	100%
	(ii) Capacitors	1 Set
	(iii) Fuses of each types and rating	200%

	(iv)	Fuse free Circuit breakers	5% or 1 No. of each type and rating, whichever is more
	(v)	Electronic modules of all types.	10% or 2 Nos. of each type and model, whichever is more
	(vi)	Indication Lamps	100%
	(vii)	Lamp holders with series resistor, if any.	10% or 2 Nos. of each type, whichever is more.
	(viii)	Cooling Fans	10% or 2 Nos. of each type, whichever is more.
	(ix)	Relays of all types including overload relays	10% or 2 Nos. of each type whichever is more.
8.00.00	**PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE)**		
	1	Valves of all types and models	10% or 1 No. of each type, class, size and model whichever is more.
	2	2 way, 3way, 5way valve manifolds	10% or 1 No. of each type, class, size and model whichever is more.
	3	Fittings	10% or 1 packet of each type, class, size and model whichever is more.
	4	Purge meters	5% of each model or 1 No. which ever is more.
	5	Filter regulators	20% of each model or 2 Nos. whichever is more.
9.00.00	**INSTRUMENTATION CABLE, INTERNAL WIRING & ELECTRICAL FIELD**		
	(i)	Pre fabricated cable of each type.	10% of installed quantity
	(ii)	Pre fabricated cable connector of each type.	10% or 1 No. of each typeand model, whichever is more.
	(iii)	Other cables	5 % of each type, pair and size of actual installed quantity

Clause No.	LIST OF MANDATORY SPARES FOR SG & AUXILIARIES	
10.00.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES**	
	1 Pneumatic and electro-hydraulic actuator assembly	10% or 1 No. of each type, model and rating, whichever is more
	2 Position feed back transmitter	10% or 2 Nos. of each type, whichever is more.
	3 Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 Set for each type of control valve, whichever is more.
	4 Diaphragms, O' rings, seals etc. of all types, make etc.	100%
	5 Pneumatic air-filter/Regulator of each type, make, rating etc.	10% or 2 Nos. whichever is more
	6 Pressure Gauges of all types, make, rating etc.	10% or 2 Nos. of each type whichever is more.
	7 Solenoid valves	10% or 2 Nos. of each type whichever is more.
	8 Air lock relays	10% or 2 Nos. of each type whichever is more.
	9 Pneumatic relays	10% or 2 Nos. of each type whichever is more.
	10 Positioner unit	20% or 2 No. of each type whichever is more
11.00.00	**ELECTRICAL ACTUATORS**	
	1 Actuators for each type of damper	1 No. of each type.
12.00.00	**PLC CONTROL SYSTEM**	
	1 Power Supply Unit	2 Nos. of each type and model
	2 Electronic modules.	2 Nos. of each type and model
	3 Central processor Unit	2 Nos. of each type and model
	4 Electrical Modules (other than those covered above)	2 Nos. of each type and model
	5 Interconnecting Cables	1 run length of each type and size

CLAUSE NO.			
3.03.09	**CONTROL VALVES, ACTUATORS & ACCESSORIES**		
	a	Position feed back transmitter	10% or 2 Nos. of each type, whichever is more. (1 LOT)
	b	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 Set for each type of control valve, whichever is more. (1 LOT)
	c	Diaphragms, O' rings, seals etc.	100% of all types, make etc. (1 LOT)
	d	Pressure Gauges of all types, make, rating etc.	10% or 2 Nos. of each type whichever is more. (1 LOT)
	e	Solenoid valves	10% or 2 Nos. of each type whichever is more. (1 LOT)
	f	Positioners unit	20% or 2 Nos. of each type whichever is more. (1 LOT)
3.03.10	**PLC Based CONTROL SYSTEM (To be provided for each plant with PLC based Control System)**		
	a	Cooling Fan in PLC system/cabinet	10% or 2 Nos. whichever is more. (1 LOT)
	General Notes :		
	1.	Unless stated otherwise, a set means item or sub items required for each type/ size, range of the assembly/sub assembly, required for complete replacement in single equipment/system as the case may be. It is further intended that the assembly sub assembly which have different orientation	

(like Left hand or Right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/sub assembly, these shall be considered as different types of assembly/sub assembly.

2. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by the bidder shall be the specified percentage (%) of the total population required to meet the specification requirements for 3x250 MW units.

   In case the quantity of mandatory spares so calculated happens to be a fraction, the same shall be rounded of to next higher whole number.

3. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.

4. In case spares indicated in the list are not applicable to the particular design offered by the bidder. The bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

5. **Interchangeability and Packings:**

   All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre set and/or preprogrammed for ready use at sight. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre setting/pre programming before putting them in to service. The spare shall be treated and properly packed for long term storage of spares under the climatic conditions prevailing at the sight e.g. small items shall be packed in sealed transparent plastic bags with desicator packs as necessary. Bidder shall furnish preservation techniques/procedures for long term storage along with their dispatch document.

6. **Identification:**

Each spare shall be clearly marked and labeled on the out side of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.

TECHNICAL SPECIFICATION

FOR

MILL REJECT SYSTEM

(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
d) Erection and Commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for Mill Reject Handling System.
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL
i) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
j) Motor shall meet minimum requirement of motor specification.
k) LT power & control cables shall meet minimum requirement of LT power & control cables specification.
l) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical equipment Specification for "MILL REJECT HANDLING SYSTEM" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor.
b) Technical specification, datasheets & quality plans for 415V Electric motors.
c) Technical Specification, datasheets & quality plans for LT power & control cables.
d) Technical Specification, datasheets & quality plans for cabling, earthing & lightning protection.
e) Electrical Load data format.

5.0 In case of conflict between any requirement mentioned in case of "General technical requirements for LV motors" (Doc No. - PE-SS-999-506-E101 Rev 00) / Technical Datasheet-A & "NTPC specification of motor", mentioned clause in NTPC specification shall prevail.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : MILL REJECT SYSTEM

PROJECT: 1X500MW UNCHAHAR TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415 V Switchgear	BHEL	BHEL	415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. DC supply (battery bank, charger etc) and any other supply as required for PLC/control panel (as applicable) shall be provided by vendor.
2	Local Push Button Station (for motors)	VENDOR	VENDOR	Located near the motors.
3	Power cables, control cables and screened control cables a) both end equipment in vendor's scope b) one end equipment in vendor's scope & one end in BHEL scope.	 BHEL BHEL	 Vendor BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL.Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system a) for cables in main route b) for cables in branch route	 BHEL Vendor	 BHEL Vendor	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands. 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Cabling shall be through conduits. However vendor can use the trunk route where available for laying of cables. Conduits shall be supplied by vendor and shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to BHEL approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	Vendor	Vendor	
10	Below grade grounding	BHEL	BHEL	
11	Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to BHEL approval at contract stage.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : MILL REJECT SYSTEM

12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle	Vendor	-	
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection detail for the above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for control cables for vendor supplied equipment (soft copies in the BHEL cable schedule format) shall be furnished during detail engineering by vendor.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable routing details marked on the drawing as per BHEL interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical equipment GA drawing	Vendor	-	

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/BHEL after award of contract.
2. All QPs shall be subject to approval of BHEL after award of contract without any commercial implication.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement ofr rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechnical vibration of rotatinf electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be sutable fro mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechnical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise statedin Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

1.0	Design ambient temperature	:	50 ºC
2.0	Maximum acceptable kW rating of LV motor	:	200 KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%, 11/3.3kV ± 6%,
	b) Rated frequency (with variation)	:	50 Hz ± 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	40 kA for 1 sec for 11kV & 3.3kV 45 kA for 1 sec for 415V system
	e) LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to Class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
7.0	Power cables data	:	Details attached
8.0	Earth Conductor Size & Material	:	Details attached
9.0	Space heater supply	:	240 V, 1¢ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.2 kW
11.0	Locked rotor current		
	a) Limit as percentage of FLC	:	Details as per spec attached
	b) Permissible tolerance, if any	:	±20%
12.0	Energy Efficient Motors	:	Details as per spec attached
13.0	Additional tests	:	As per QP
14.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
15.0	Makes	:	ABB/ Bharat Bijlee/ CGL / KEC/ NGEF/Siemens/ALSTOM (SUBJECT TO CUSTOMER APPROVAL DURING DETAILED ENGG)

Note: **Motor name plate rating at 50ºC shall have at least 10% margin over input power requirement at rated duty point unless otherwise stated in driven equipment specification**

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 The auxiliary AC voltage supply arrangement shall have 11kV, 3.3 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition :

(a) 11kV, 3.3 kV +/- 6%

(b) 415/240V +/- 10%

1.06.00 The voltage level for motors shall be as follows :-

a) Upto 0.2KW : Single phase 240V AC / 3 phase 415V AC

b) Above 0.2KW and upto 200KW : 3 phase 415V AC

c) Above 200KW and upto 1500 KW: 3.3 kV

d) Above 1500 KW : 11 kV

Voltage rating for special purpose motors viz. screw compressors and those with VFD shall be as per manufacturer standard.

For CHP conveyor's motor above 160KW rating 3.3KV, three phase AC supply is to be used. However all the motors on the Stacker/ Reclaimer machine shall be on 415V AC only.

1.07.00 Fault level shall be limited to 40kA RMS for 1 second for 11kV & 3.3 kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC system shall be isolated type.

1.08.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.09.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

1.10.00 Degree of Protection

Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS:325, IEC:60034
2)	Single phase AC motors	:	IS:996, IEC:60034
3)	Crane duty motors	:	IS:3177, IEC:60034
4)	DC motors/generators	:	IS:4722
5)	Energy Efficient motors	:	IS 12615

3.00.00 TYPE

3.01.00 **AC Motors:**

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be Energy Efficient motors, Efficiency class-Eff 1, conforming to IS 12615.

c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

3.02.00 DC Motors Shunt wound.

4.00.00 RATING

(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

(b) Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings

shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

(c) For BFP motor the starting MVA shall be restricted to 58 MVA.

5.00.00 TEMPERATURE RISE

Air cooled motors

70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.

Water cooled

80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.

41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class Y wet wound Boiler circulation pump motor.

6.00.00 OPERATIONAL REQUIREMENTS

6.01.00 **Starting Time**

6.01.01 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

6.01.02 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

6.01.03 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

6.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

6.02.00 **Torque Requirements**

6.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

6.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

6.03.00 **Starting voltage requirement**

(a) 85% up to 1500KW (except for AOP motor which is 80%)

(b) 80% from 1501 KW to 4000KW

(c) 75% > 4000KW

7.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

7.01.00 Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors , space heater terminals inside the main terminal box may be acceptable.

7.02.00 All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below

(a) Fuel oil area : Group – IIB

(b) Hydrogen generation plant area : Group - IIC (or Group-I, Div-II as per NEC)

7.03.00 Winding and Insulation

(a) Type : Non-hygroscopic, oil resistant, flame resistant

(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. However the conveyor motor shall be suitable for 3 consecutive hot starts.

(c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation.
The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15

(d) 240VAC, 415V AC & 220V DC motors : Thermal Class(B) or better

7.04.00 Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.

7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.
7.08.00	Motor body shall have two earthing points on opposite sides.
7.09.00	HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. In case cable box is offered, then Employer shall provide termination kit. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
7.10.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.11.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.12.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.13.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.14.00	11kV and 3.3 kV motor Terminal Box shall be suitable for fault level of 750MVA for 0.12 sec and 250 MVA for 0.12 sec respectively. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.15.00	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP Motor.

	(a) Upto 110KW : 11.0 (For AOP motor it shall be 8.0) (b) Above 110KW & upto 1500KW : 10.0 (c) Above 1500KW & upto 4000KW : 9.0 (d) Above 4000KW : 6 to 6.5
9.00.00	CW Motor shall be desigined with minimum power factor of 0.8 at design point.
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII-(BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
10.01.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the owner for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
10.01.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED"and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this

contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

10.01.05 **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

(a) No load saturation and loss curves upto approximately 115% of rated voltage

(b) Measurement of noise at no load.

(c) Momentary excess torque test (subject to test bed constraint).

(d) Full load test(subject to test bed constraint)

(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

(f) Lightning Impulse withstand test on the sample coil shall be as per IEC-60034, part-15

(g) Surge-withstand test on interturn insulation shall be as per clause no. 5.1.2 of IEC 60034, part-15

10.01.06 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

10.02.00 **LT Motors**

10.02.01 LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening.

	These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
10.02.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.
10.02.03	**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED** **The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only** 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip . 5. Temperature rise test . 6. Momentary excess torque test. 7. High voltage test . 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section) 10. Test for degree of protection and 11. Overspeed test.
10.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
10.04.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	**Minimum distance between centre of stud and gland plate in mm**
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	**Clearance**
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

LT CONTROL CABLES

1.00.00 **CODES & STANDARDS**

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 **TECHNICAL REQUIREMENTS**

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Conductor of control cables shall be made of stranded, plain annealed copper.

2.04.00 PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

2.06.00 For multicore armoured cables, the armouring shall be of galvanised steel as follows:

Calculated nominal dia of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire
Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29. (As per IS 10810 Part-58)

(b.) Acid gas emission of max. 20% (As per IEC-754-I)

(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2.08.00 Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue and Black

5 core - Red, Yellow, Blue, Black and Grey

2.09.00 For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the

cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath:

(a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed.

The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.

2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.

2.12.00 Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.

2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

2.14.00 Cable selection & sizing

Control cables shall be sized based on the following considerations:

(a) The minimum conductor cross-section shall be 1.5 sq.mm.

(b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL
5C	1
7C-12C	2
14C & above	3

2.14.01 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

2.14.02 Cables shall be armoured type if laid in switchyard area, CHP area or directly buried.

3.00.00 CONSTRUCTIONAL FEATURES

3.01.00 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).

4.00.00 CABLE DRUMS

(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.

5.00.00 **TESTS**

All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price

The type test reports once approved for any projects shall be treated as reference . For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 TYPE TESTS

5.01.01 The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering

S. No.	Type Test	Remarks
	For Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires (If applicable)	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Wrapping test	For aluminium wires / formed wires only.
7.	Resistance test	
8(a).	Mass of zinc Coating test	For GS wires/formed wires only
8(b).	Uniformity of zinc coating	For GS wires/formed wires only
9.	Adhesion test	For GS wires/formed wires only
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test	before ageing and after ageing
12.	Ageing in air oven	

S. No.	Type Test	Remarks
13.	Loss of mass test	For PVC insulation and sheath only
14.	Hot deformation test	For PVC insulation and sheath only
15.	Heat shock test	For PVC insulation and sheath only
16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only
18.	Oxygen index test	For outer sheath only
19.	Smoke density test	For outer sheath only
20.	Acid gas generation test	For outer sheath only
	For completed cables	
21.	Insulation resistance test(Volume resistivity method)	
22.	High voltage test	
23.	Flammability test as per IEC-332 Part-3 (Category-B)	

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed with this chapter

LT POWER CABLES

1.00.00 **CODES & STANDARDS**

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 **TECHNICAL REQUIREMENTS**

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.

2.04.00 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.

2.06.00 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :

Calculated nominal dia. of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

2.06.01 The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

2.06.02 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.

2.07.00	Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29 (as per IS 10810 Part-58). (b.) Acid gas emission of max. 20% (as per IEC-754-I). (c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black
2.09.00	For reduced neutral conductors, the core shall be black.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum, over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	Cable selection & sizing
2.14.01	Cables shall be sized based on the following considerations: (a) Rated current of the equipment

(b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage

(c) Short circuit withstand capability

This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.

2.14.02 Derating Factors

Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

a) Variation in ambient temperature for cables laid in air

b) Grouping of cables

c) Variation in ground temperature and soil resistivity for buried cables.

2.14.03 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

2.14.04 Cables shall be armoured type if laid in switchyard area, CHP area or directly buried.

2.14.05 All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.

3.00.00 **CONSTRUCTIONAL FEATURES**

3.01.00 1.1 KV Grade Power Cables

(a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I).

(b) 1.1KV grade PVC power cables shall have aluminium conductor(compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I).

(c) 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-

sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.

3.00.00 CONSTRUCTIONAL FEATURES

(a.) **1.1 KV grade XLPE power cables** shall have compacted aluminium conductor, XLPE insulated, PVC inner sheathed (as applicable), armoured/ unarmoured, FRLS PVC outer sheathed conforming to IS:7098. (Part-I).

(b.) **1.1KV grade PVC power cables** shall have aluminium conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed, armoured/ unarmoured, FRLS PVC outer sheathed conforming to IS:1554 (Part-I).

4.00.00 CABLE DRUMS

(a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c) The standard drum length for power cables shall not be less than 500 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.

5.00.00 TESTS

1.0 All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements,

the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.

3.0 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

4.0 The type test reports once approved for any projects shall be treated as reference . For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 **Type Tests**

5.01.01 The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering:

S.No.	Type test	Remarks
	For Conductor	
1.	Resistance test	
2.	Tensile test	For circular non-compacted conductors only
3.	Wrapping test	For circular non-compacted only
	For Armour Wires/ Formed Wires	
4.	Measurement of Dimensions	
5.	Tensile Test	
6.	Elongation test	
7.	Torsion test	For round wires only
8.	Wrapping test	For aluminium wires / formed wires only.
9.	Resistance test	
10(a)	Mass of zinc coating test	For GS Formed wires/wires only
10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
11.	Adhesion test	For GS Formed wires/wires only

	For PVC/XLPE insulation & PVC Sheath	
12.	Test for thickness	
13.	Tensile strength & elongation tests	before ageing and after ageing
14.	Ageing in air oven	
15.	Loss of mass test	For PVC insulation and sheath only
16.	Hot deformation test	For PVC insulation and sheath only
17.	Heat shock test	For PVC insulation and sheath only
18.	Shrinkage test	
19.	Thermal stability test	For PVC insulation and sheath only
20.	Hot set test	For XLPE insulation only
21.	Water absorption test	For XLPE insulation only
22.	Oxygen index test	For outer sheath only
23.	Smoke density test	For outer sheath only
24.	Acid gas generation test	For outer sheath only
	For completed cables	
25.	Insulation resistance test (Volume resistivity method)	
26.	High voltage test	
27.	Flammability test as per IEC-332 Part-3 (Category-B)	

Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed with this chapter.

INDUCTION MOTOR & SYNCHRONOUS MACHINE

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y					Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y	Y		Y		
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y						
Motor (IS 325 / 4722/ 9283)	Y	Y	Y						

INDUCTION MOTOR & SYNCHRONOUS MACHINE

TESTS/CHECKS / ITEMS/COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All routine & acceptance tests as per IS-325/IS-4722 /IS-9283/IS 2148/IEC 60079-I	vibration	Over speed	Tan delta, shaft voltage & polarization index test
Plates for stator frame, end shield, spider etc.									
Shaft									
Magnetic Material	Y		Y						
Rotor Copper/Aluminium									
Stator copper			Y						
SC Ring									
Insulating Material			Y						
Tubes for Cooler		Y							
Sleeve Bearing		Y							
Stator/Rotor, Exciter Coils									
Castings, stator frame, terminal box and bearing housing etc.									
Fabrication & machining of stator, rotor, terminal box									
Wound stator									
Wound Exciter									
Rotor complete				Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly									
Accessories, RTD, BTD,CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.									
Motor (IS 325 / 4722 / 9283/2148/IEC 60079-I)						Y	Y	Y	Y1

Note : 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalisation. However, No QP for LT motor upto 50KW.

2. Makes of all major bought out items will be subject to NTPC approval.
Y1 = for HT Motor / Machines only.

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/NBPPL SPEC./RELEVANT STANDARD	NBPPL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER NBPPL SPEC.	MA	-DO-	100%	IS-325/ NBPPL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	

QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :	
	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION TITLE :	

SHEET 2 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, NBPPL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN NBPPL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. NBPPL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

NBPPL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 1 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. NBPPL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 3 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY NBPPL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

NBPPL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 4 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	NBPPL DATA SHEET	NBPPL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ NBPPL SPEC.	MANUF'S SPEC./ NBPPL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

NBPPL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ NBPPL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/NBPPL SPEC./ RELEVANT STAND	NBPPL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 6 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./NBPPL SPEC.	MANUFR'S SPEC./NBPPL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

NBPPL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 8 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER NBPPL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ NBPPL SPEC./ DATA SHEET	IS-325/ NBPPL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER NBPPL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	NBPPL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	NBPPL SPEC. & DATA SHEET	NBPPL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY NBPPL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, NBPPL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN NBPPL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. NBPPL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

NBPPL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

1 X 500 MW FGUTPP

MILL REJECT HANDLING SYSTEM (MRHS)

(INCLUDING COMPRESSED AIR SYSTEM FOR MRHS)

BIDDER'S SCOPE FOR C&I

1. GENERAL

The Contractor shall provide complete Instrumentation & Local control panels for control, monitoring and operation of Mill Reject Handling system & Air compressors for Mill Reject Handling system. Also, Contractor shall provide MP/PLC based control system for control, monitoring and operation of Compressed Air system of MRHS. The requirements given below are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.

Further Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the Bidder and for meeting the intent and requirements of the specification.

In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.

The make/model of various instruments/items/systems shall be as per NTPC/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable.

In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

The design, manufacture, inspection, testing & installation of all C&I equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned in Chapter- Reference Codes, Section-C3 of technical specification and all other applicable VDE, IEEE, ANSI, ASME,NEC, NEMA, ISA AND Indian Standards and their equivalents.

2. CONTROL SYSTEM

a) The controls for MRHS shall be realized in DDCMIS based control system (DDCMIS not in Bidder's scope) & Air compressors for MRHS shall be MP/PLC based. MP/PLC based panels for Air Compressors shall have a provision for soft as well as hardwired interface with DDCMIS. The overall control of MRHS & Air compressors for MRHS shall be from DDCMIS. Contractor to consider hardwired remote start/stop, hardwired feedbacks for Compressor On, off & Trip & loading/unloading of Air compressors from MP/PLC panel to DDCMIS as a minimum. Also, the Mill reject handling system & Air compressors for MRHS shall be controlled from GIUs located in field.

   Local control panels shall be provided for local control & monitoring of Transporter vessels/Denseveyors of Mill Reject Handling system. Separate panels shall be provided for each transport vessel. The panel shall be hooked-up with DDCMIS panel placed in CCR for overall control & monitoring from CCR.

b) PLC system along with associated HMI shall be provided by Contractor as per Specification for PLC, PC, Printer enclosed in Chapter- Control System, Section-C3 of technical specification.

   If a separate PLC based control system is offered by Contractor for Air compressors of MRHS, then 2 nos. EWS/OWS, 1 no. A4 Color laser jet printer shall also be provided by Contractor along with the required furniture for placing the EWS/OWS & printer.

   Further, 24V DC Power supply system shall also be provided as per the specification enclosed in Chapter-Control System, Section-C3 of technical specification.

c) List of signals to be exchanged between MP/PLC & DDCMIS shall be furnished by Contractor during detailed engineering in the signal exchange list format enclosed in the Chapter-DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT, Section-C3 of technical specification.

d) Contractor shall furnish Instrument Schedule, JB grouping, List of Instruments/devices for HART in NTPC/BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in NTPC/BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

3. MEASURING INSTRUMENTS

Contractor shall provide primary instruments like Microprocessor based transmitters and temperature transmitters employing HART protocol, thermocouples & RTDs, pressure/diff. Pressure/ temperature/flow/ level switches & gauges for :

a) All the instruments shown in the tender P&IDs as a minimum.

b) All the instruments which are not shown in the tender P&ID but are required for safe & reliable operation of the plant.

c) Temperature transmitters are to be provided by the contractor for all the temperature elements in the scope of the contractor. Compensating Cables, JB/rack & other erection hardware shall also be in scope of contractor.

d) All the instruments shall be terminated up to JBs by Contractor. JBs shall be in Contractor's scope.

e) Contractor shall provide Instrument stubs on pipes for mounting instruments as per Instrument Stub Details defined in Chapter- MEASURING INSTRUMENTS, Section-C3 of technical specification.

   Also, contractor to provide & mount the root valves for instruments on the pipes. All accessories required for mounting the root valves shall be in scope of MRHS package contractor. The impulse pipe required for mounting the instruments shall also be in Contractor’s scope.

f) Solenoid valves shall be provided as per detailed specification in Chapter-Measuring Instruments, Section-C3 of technical specification. Also, limit switches (as per Limit switch specification in Chapter-Electric actuators with Integral starter, Section-C3 of technical specification) shall be provided with all solenoid valves for open/close feedback.

g) RF Type level switches shall be provided for interlock & monitoring purpose on transport vessels & Bunkers.

h) 230 VAC UPS supply shall be provided by BHEL at a single point. Further distribution to various instruments shall be in Bidder’s scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder’s scope. Bidder to furnish UPS power requirement along with the bid.

i) All panels, desks, cabinets etc. shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be

connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

Shield on instrumentation cables shall be grounded on panel side. When shielding termination is required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground.

The Contractor shall submit with the offer recommended grounding scheme required for the system being offered by contractor. The exact grounding scheme shall be finalized during detailed engineering.

j) Detailed specification of instruments, Local Control panels, JB etc. & Instrument Stub details, Instrument installation diagrams shall be as defined in Chapter- MEASURING INSTRUMENTS, Section-C3 of technical specification.

4. INSTRUMENTATION CABLES & CONTROL CABLES

Scope of Instrumentation cables (Screened Control Cables) & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification.

Special cables (Compensating cable, Pre-fab cable, etc.) shall be in Contractor's scope.

Cabling philosophy shall be as defined in Chapter- CABLING PHILOSOPHY, Section-C3 of technical specification.

5. ELECTRIC ACTUATORS

Electrical Actuators with Integral starter shall be provided by Contractor for all on/off and inching type valves in MRHS package (including Air compressors for MRHS) along with necessary interface units for linking to Control System as applicable as detailed out in Chapter- Electric Actuators with Integral Starter, Section-C3 of technical specification.

6. CONTROL VALVES & ACTUATORS

a) Control valves, actuators and accessories, shall be provided by Contractor meeting requirements specified under Chapter- CONTROL VALVE, ACTUATORS & ACCESSORIES, Section-C3 of technical specification. Specially designed valves/trims to prevent cavitation and limit noise and control outlet velocity, shall be provided.

b) Microprocessor Based Electronic Positioner is to be provided with all the Control valves being provided by the Contractor.

c) Quality assurance for Control valve has been enclosed for a broad scope of Quality tests to be performed. However, final Quality plan for Control valve shall be as per

Control Valve manufacturer's agreed Quality plan with NTPC. Endorsement of the same shall be forwarded to BHEL for obtaining approval from NTPC.

In case, control valve manufacturer does not have any agreed Quality plan with NTPC, Control Valve manufacturer to obtain approval on its Control Valve Quality plan from NTPC on its own. MRHS contractor shall be fully responsible for obtaining approval of the Control Valve Quality plan. No commercial & delivery implication in this regard shall be acceptable.

7. TYPE TEST REQUIREMENT

The type tests to be conducted for C&I systems & equipments shall be as detailed out in Chapter- C&I TYPE TEST, Section-C3 of technical Specification.

8. QUALITY ASSURANCE

Contractor shall perform tests of C&I items/instruments/systems as per Chapter- QUALITY ASSURANCE FOR C&I, Section- C3 of the technical specification.

9. DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

Documents to be submitted after award of Contract shall be as defined in Chapter- DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT, Section-C3 of technical specification.

10. C&I MANDATORY SPARES

Contractor to provide Mandatory spares for C&I items as defined in the Main Mandatory spares list enclosed in the technical specification.

Notes:

1. Here **'Contractor'** is being referred as Successful bidder.

CHAPTER

REFERENCE CODES

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS

23.20.00 **Miscellaneous**

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Creteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes.
Publication	

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).
   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).
5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.
6. Printed circuit boards - IPC TM - 650, IEC 326 C.
7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).
11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).
12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.
13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.
14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.
15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.

2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).

2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).

3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

~~**Apparatus, enclosures and installation practices in hazardous area**~~

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.

2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.

3. Instrinsically safe apparatus - NFPA 493 1978.

4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.

5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.
3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106
4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3,90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC

6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.

7. Printed Circuit Board - IPC TM 650, IEC 326C.

8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.

2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.

3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).

4. Codes for pressure piping - ANSI B 31.1

5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.

2. Seamless carbon steel pipe ASTM - A - 106.

3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.

4. Material for socket welded fittings - ASTM - A - 105.

5. Seamless ferritc alloy steep pipe - ASTM - A - 335.

6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.

7. Composition bronze of ounce metal castings - ASTM - B - 62.

8. Seamless Copper tube, bright annealed - ASTM - B - 168.

9. Seamless copper tube - ASTM - B - 75.

10. Dimension of fittings - ANSI - B - 16.11.

11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.

2. Material of socketweld fittings - ASTM - A105.

3. Dimensions of fittings - ANSI - B - 16.11.

4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)
8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.
9. Oxygen index and temperature index test - ASTM D - 2863.
10. Smoke density measurement test - ASTMD - 2843.
11. Acid gas generation test - IEC - 754 - 1.
12. Swedish Chimney test - SEN - 4241475 (F3).
13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.
14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.
15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating staiton (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.
2. -do- Test Standards. NEMA VE-1-1979.
3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.

CHAPTER

CONTROL SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**CONTROL DESK & PANELS**
1.01.00	**GENERAL**
1.01.01	All control desk, panels, LVS panel etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.
1.01.02	All panels, desks, cabinets shall be free standing type & have bottom / top entry for cables to be finalised application wise during detailed engineering stage. The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fire proof sealing material to prevent ingress of dust and propagation of fire.
1.01.03	All wiring shall be arranged to enable the removal of instruments/devices without unduly disturbing them.
1.01.04	Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk.
~~1.01.05~~	~~Contractor shall provide the Control Desk (CD), LVS panel, PC racks independent~~ and dedicated for each of the units and other subsystems of ~~DDCMIS~~ to be mounted in the respective control room.
1.01.06	All ~~Control~~ Desk (CD), LVS panel, PC racks shall be properly grounded. The grounding scheme shall be as approved by Employer.
1.01.07	Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. Painting and coating shall be as specified under item power supply, grounding, cabinets / panels etc., subsection DDCMIS, Part-B, Section-VI of Technical Specifications. The exact color shall be finalised during detailed engineering.
~~1.01.10~~	~~Due consideration shall be given to the ergonomics of control desk, LVS panel and~~ the control room design. The design ~~shall~~ conform to the EN ISO 11064 (~~Ergonomical~~ design of control room), Part-1,2 and 3.
2.00.00	**CONTROL DESK & PANEL**
2.01.00	**GENERAL**
2.01.01	The exact dimensions, material, construction details etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering. For bidding purpose, the length of the desk/ panel and CD mounted devices are given in Appendix-I to Part-A, Section-VI. The general arrangement of the desk/panel shall also be finalised during detailed engineering, subject to Employer's approval.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.01.02	The Contractor must pay particular attention in the positioning of desk mounted Monitors in relation to control room lighting in order to minimise reflections. CPU's for OWS and operator station shall be kept separately at the back of LVS Panels.
2.01.03	For control desk mounted instruments/ devices etc., which are to be powered from UPS, all required conversion of interface equipments / accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like Input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders. Power supply distribution scheme shall be as approved by Employer during detailed Engineering stage.
2.01.04	All work related to manufacture and assembly of control desk including their fabrication, painting, wiring, tubing installation with specified mounting accessories shall be completed and shall be fully tested prior to shipment to the project site. The manufacturing and testing of panel/desk as stated above shall be done in the manufacturing works of a qualified manufacturer acceptable to the Employer.
2.01.05	The internal wiring of the desk/panel/cabinets shall be as per Sub-Section – Inst. Cables, Part-B, Section -VI. The Contractor shall complete all the internal wiring of the desk/panel at the shop as per the final drawings as approved by the Employer, during detailed engineering. However, if any further wiring modification is required at site as per system requirement, the Contractor shall do necessary modification at site within the quoted lumpsum price.
2.02.00	**Control Desk (CD)**
2.02.01	Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. The tabletop of the control desk shall be arc-shaped for mounting monitors & Keyboards of operator work (OWS) of HMIPIS. It shall have concealed cable & wire way management system. The top surface of control desk shall be 30mm thick with the top 12mm of acrylic solid surface and the remaining 18mm of laminated medium density fibre board. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, Mouse pads, Monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal & vertical directions. PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure and the same shall be decided during detailed engineering. Sliding keyboard trays shall be provided on the CD. The CPU's of OWS etc. shall be located separately on PC racks. The desk shall be arranged in continuous arc shape. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.
2.02.02	Additional requirements for UCD(main plant): The TFT monitors and synchroscope in the control desk will remain concealed and come up to the top of the desk through an automatic (electrically operated) carriage management system. Exact details shall be finalized during detailed Engineering. All operator monitors & mice for SG, TG, BOP (irrespective of scopy of supply) shall be mounted on this CD.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.05.00	**Unit-Incharge Desk**
	Profile and construction of the Unit Incharge Desk shall be same as that of CD. Provision for Operator Work Station and PA system/ telephone handset etc. shall be provided similar to the Control Desk. The exact profile, dimensions, general arrangement and the radius of curvature shall be finalised during detailed engineering without any price repercussion to the Employer.
2.06.00	**Internal Panel/Desk Items**
2.06.01	Equipment and devices mounted within the panels/desk (whether supplied by the Contractor or by others) shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work. Locations for internal panels/desk devices shall be as per Employer approved drawings showing their exact location.
2.07.00	**Furniture**
	Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe. 1 Work Station furniture Modular work station furniture, suitable for mounting programmer stations, PC based systems, printers (inkjet or A4 laser) etc. being supplied by both the contractor and the Employer, are to be provided. The quantities of Employer's programmer station etc. to be accommodated are indicated at Appendix-I to Part A of technical specifications. Each module shall consist of document rack with transparent cover and adjustable partition, tilt adjustable foot rest, Sliding keyboard tray with adjustable height and tilt, telephone arm, storage tray, copy holder, paper tray, task light etc. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology. The thickness of board on which Monitor, CPU & printer are to be mounted shall not be less than 25 mm 2 PC rack PC rack shall be provided to mount CPUs of work stations/PCs of OWS/LVS etc in Control Room. PC rack shall be of modular in design. Each module shall have transparent cover and adjustable partition. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology. The thickness of board on which Monitor, CPU & printer are to be mounted shall not be less than 25 mm

CLAUSE NO.	TECHNICAL REQUIREMENTS
	modules in racks, wiring and cabling techniques, termination method for field cables, inter cubicle to control desk connections, test facilities provided, etc.
9.03.12	Field termination cabinets, physically separate from system cabinets, shall be provided for termination of field signals and mounting of Field termination modules **(In case it is the standard practice of the Bidder to mount Field Termination modules (FTMs) in the system cabinet itself, Bidder shall clearly bring out the same in his offer with details of systems executed with this philosophy, for Employer's review).** All the incoming signals shall be grouped as per their origin and will be terminated The grouping of these signals shall be subject to Employer's approval. For this purpose, the Bidder shall refer to the drawing no 000-999-POI-A-063/ 65. In case the system cabinets and the field termination cabinets are manufactured as a suite of panels, then suitable isolation shall be provided between the two. The isolation sheet shall be provided with suitable holes with grommets for routing of cables between the system cabinet and the field termination cabinet.
9.03.13	The type of termination and terminal blocks to be used in the relay cum termination/ Field Termination cabinets shall be as per requirements specified under Sub-Section-Inst. Cable. The terminals used for terminating the spare cores/ pairs of field cables shall not be employed for terminating the spare channels of I/O modules/ FTMs.
9.03.14	The protection class of cabinets and environmental rating shall be as defined in Basic Design Criteria. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-Basic Design Criteria (Part-B, Section-VI) and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If fans/blowers are required for satisfactory system operation, dual blowers/fan with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.
9.03.15	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
9.03.16	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or

angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 600 mm, double doors shall be provided.

9.03.17 Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish color shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment. The touch up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

The finish colors for exterior and interior surfaces shall conform to following shades:

Front & Rear-RAL 9002; End panel side- RAL 5012. Internal color shall be same as external color.

Paint films which show sags, checks or other imperfections shall not be acceptable.

9.03.18 Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.

9.03.19 All alarm contacts located within cabinets as well as inputs/outputs from other related system shall be suitably terminated in the cabinets.

9.03.20 The Contractor may submit details of his standard wiring practice for similar application for consideration and approval of Employer.

~~9.04.00~~ ~~Relays~~

9.04.01 All the relays provided by Contractor shall be suitable for control supply of 24V DC. Each relay shall have 2 changeover type contacts & the rating of contacts shall be 5 Amp at 240V AC & 0.2A at 220V DC. The VA burden of relays shall be suitable to match the capacity of output modules (however, it shall not be more than 2.5 VA). Each relay shall be provided with a freewheeling diode. The relays shall be mounted in Field termination cum relay cabinets. All the contacts of relays shall be wired upto the cabinet terminal blocks.

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES**
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at IID-01, Part-A, Section VI.
1.02.00	The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID.
1.03.00	All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-Section - MEAS INST, Part-B, Section VI. In addition, all electrical instrument devices like switches/ transmitters/ controllers/analysers/solenoid valves which are located in the field/hazardous locations shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.
1.04.00	Contractor shall provide independent control systems for safe, efficient and reliable operation of each of the plant auxiliary systems. The type of control system shall be as indicated under scope part at IID-01, Part-A, Section VI.
1.05.00	ON/OFF control, indication, annunciation of incomers and bus-coupler (even if they are not in the scope of the contractor) are also to be performed from Contractor's Control System for each of the plant auxiliary system as applicable.
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules shall in no way jeopardise safety of plant and personnel.
1.07.00	The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit, instrument air supply failure etc. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the

CLAUSE NO.	TECHNICAL REQUIREMENTS
	safety of plant/personnel/equipment and as finalised during detailed engineering. System shall be designed such that there will be no upset when Power is restored.
1.08.00	The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System (HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault, failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as colour change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.
1.09.00	The Control system shall operate in non-air conditioned area and shall meet the minimum requirements as specified below. The Control system shall meet the minimum requirements as specified below.
1.10.00	Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-151-POI-A-013.
2.00.00	**PROGRAMMABLE LOGIC BASED CONTROL SYSTEM**
2.01.00	**PLC PROCESSOR** The processor unit shall be capable of executing the following functions:- a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. b Implementing all logic functions for control, protection and annunciation of the equipment and systems. c Implementing modulating control function for certain application as specified elsewhere in the specification. d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. e Performing self-monitoring and diagnostic functions.
2.02.00	Wherever Dual processor based PLC system has been specified, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	Wherever multiple functional groups have been specified/ required , the above requirements is applicable for each functional group.
2.03.00	The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.
2.04.00	Priority of different commands shall be as follows:
2.04.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.
2.04.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.
2.05.00	**HUMAN MACHINE INTERFACE SYSTEM (HMIS)**
2.05.01	Graphical Interface Unit (GIU) / Operator work station (OWS) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface System. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided.
2.05.02	Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS.
2.05.03	All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions.
2.05.04	The operator functions for each OWS / GIU shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalised during detailed engineering.
2.05.05	The display selection process shall be optimised so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.05.06	The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorised use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalised by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator). When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.
2.05.07	Wherever Graphical Interface Unit is envisaged, it shall meet the minimum functional requirements of monitoring, operating & controlling the process and displaying information related to process locally. GIU shall be provided with TFT active matrix display and keypad for operation. GIU shall be ruggedly designed to withstand hard environments like high temperature, shock and vibration.
2.06.00	**PROGRAMMING FUNCTIONALITIES** Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly witrh graphical user interface and shall not require knowledge of any specialised language. For example, the programming of PLC shall use either of the following:- - Flow-chart or block logic representing the instructions graphically. - Ladder diagrams. The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc All programming functionalities shall be password protected to avoid unauthorised modification.
2.07.00	**SOFTWARE REQUIREMENT**
2.07.01	All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.
2.07.02	The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.
2.07.03	Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface.

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC
2.07.04	All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.
2.07.05	All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.
2.07.06	The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.
2.08.00	**PARAMETRIC REQUIREMENTS** The control system shall be designed such that under worst case loading conditions the response time shall not be worst than the following:- On/Off Command - The response time for screen update after the execution of the control command from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be two seconds (excluding the drive actuation time). Adjustment Command - 0.5 to 1 second. On screen Updating - 1 second. All Control related displays - 1 second. Bar Chart displays - 2 to 3 seconds. Plant Mimic displays - 2 to 3 seconds. Group review displays - 2 to 3 seconds. X-T Plot Displays - 1 to 2 seconds. Plant Summary Displays - 1 to 2 seconds. Even under worst case loading condition of HMIS and system Bus, each HMIS processor shall have 50 % spare time when measured over any one minute period and the system bus shall have at least 50 % spare duty cycle.
3.00.00	**INPUT/OUTPUT MODULES**
3.01.00	The PLC system should be designed according to the location of the input/output cabinets as specified.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.02.00	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays,4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drains nos. 0000-151-POI-A-065 for interface/termination requirements of Field Instruments/ Drives.
3.03.00	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
3.05.00	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.
3.06.00	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.
3.07.00	The Contractor shall provide the following monitoring features: a Power supply monitoring. b Contact bounce filtering. c Optical isolation between input and output signals with the internal circuits d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering.
3.08.00	Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog ouput modules shall be able to drive an load impedance of 500 Ohms minimum.
3.09.00	Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.
3.10.00	Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required ,shall be done by the contractor in PLC system.
3.11.00	All input field interrogation voltage shall be 24V DC or 48 V DC.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.12.00	In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper annunciation.
3.13.00	Wiring Scheme for inputs to control system shall be as follows:
3.13.01	Input used for interlock/protection shall be dual redundant. Each of the redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement scheme of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.
3.13.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:
3.13.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.
3.13.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.
3.14.00	Inputs and Outputs related to each of the redundant drives / equipments (eg. each of the 3x50 % drives, each of the storage vessel/sump/tank storing same fluid, each of the streams and its related drives etc.) shall be wired to separate input and output modules.
3.15.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers. The maximum number of inputs/outputs to be connected to each type of module shall be as follows: 1. Analog input module — 16 2. Analog output module — 16 3. Binary input module — 32 4. Binary output module — 32 5. Analog input & output (combined) — 16 6. Binary input and output (combined) — 32
3.16.00	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station screens for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the screens.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.17.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant datalink to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 300 meters from the Central PLC, fiber optic datalink has to be provided.
4.00.00	**SYSTEM SPARE CAPACITY**
4.01.00	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:
4.02.00	10% spare channels in input/output modules fully wired up to cabinets TB.
4.03.00	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.
4.04.00	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.
4.05.00	The Data communication system shall have the capacity to handle the additions mentioned above.
4.06.00	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.
4.07.00	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.
5.00.00	**DATA COMMUNICATION SYSTEM (DCS)**
5.01.00	The Data Communication System shall include a redundant Main System Bus with hot back-up . Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	The DCS shall have the following minimum features : a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station. b The design shall be such as to minimise interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module. c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility. d Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged. e The design and installation of the system bus shall take care of the environmental conditions as applicable. f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion. g Passive coaxial cables or fibre optic cables shall be employed. The Contractor shall furnish details regarding the communication system like communication protocol, bus utilisation calculations etc.
5.02.00	~~These PLC systems shall be interconnected with Fire Alarm panels also and~~ interface to DDCMIS from Fire Alarm panels is also ~~envisaged. Hence~~ if the Contractor is providing interface to DDCMIS ~~from single~~ location rather than from PLC systems separately and Fire ~~Alarm~~ panels separately the same is acceptable provided all the ~~information~~ related to Pump houses, Fire detection & protections ~~system is~~ made available to DDCMIS through single interface.
5.03.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.
6.00.00	**SYSTEM REACTION TIME**
6.01.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of

programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.

7.00.00 OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS

7.01.00 Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalised during detailed Engg. stage.

7.02.00 Minimum quantities shall be as follows:-

1 Various displays on the OWS shall as a minimum include P&ID displays or mimic, bar chart displays, X-Y & X-T plot (trend) displays, operator guidance message displays, group displays, plant start-up/shutdown message displays, system status displays etc. Number of displays and the exact functionality shall be on as required basis and as finalised during detailed engineering subject to the minimum quantities as given in subsequent clauses. For X-T & X-Y plots, the facility of providing a background grid on operator request shall be variable with adequate no. Of divisions in both co-ordinates.

2 The minimum quantity of major types of displays per unit shall be as follows:

A)	CONTROL DISPLAYS (GROUP/SUB-GROUP/ SEQUENCE/LOOP)	(ON AS REQD. BASIS SUBJECT TO 100 MINIMUM)
B)	P&ID/ MIMIC DISPLAY	20
C)	X-Y PLOT (WITH SUPERIMPOSED OPERATING CURVES + USING USER SELECTABLE STORED DATA)	25 + 25
D)	GROUP DISPLAYS	20
E)	OPERATOR GUIDANCE MESSAGE	10
F)	SYSTEM STATUS & OTHER DIAGNOSTIC DISPLAY	ON AS REQUIRED BASIS

The assignment for the above will be done by the contractor as per the requirement of operation of contractor's system as well as for maintenance. The balance displays shall be left as spare for future modification/addition.

8.00.00 HISTORICAL STORAGE AND RETRIEVAL SYSTEM (HSRS)

8.01.00 The HSRS shall collect, store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data .
8.02.00	The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports . The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical stor e. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk.
8.03.00	In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based an various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of alarms, logs, reports, etc.
9.00.00	**CONTROL & POWER SUPPLY SCHEME**
9.01.00	**General Requirements** Necessary redundant transformers and redundant chargers with 24 V DC battery back-up shall be provided by the Contractor to derive power supply from 415V, 3-phase 3-wire incomers to be arranged by the Contractor at the input terminals of power supply cabinets. The Contractor shall, hower furnish all required hardware/ equipment/ cubicles for conversion and/or stabilization of the power source provided by the Owner to all other levels which may be necessary for meeting the individal requirements of equipments/ systems furnished by him within the Contractor,s quoted lumpsum price. 24 V DC power supply system shall be provided as below:- i) Power supply for each PLC based control systems and each remote I/O system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller –one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board ii) One set of 24V DC power supply system for each Fire alarm panel and Repeater fire alarm panel with 12 hours battery back up as per manufacturer's standard practice.
9.02.00	**POWER SUPPLY SYSTEM FOR PLC BASED CONTROL PANELS**
9.02.01	Microprocessor based, Intelligent, Modular Power Supply
9.02.02	Microprocessor based, intelligent, modular power supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float / Boost mode. Either of the bank of rectifier modules shall be able to re-charge the fully discharged battery within 8 hours automatically on-line. It shall also be possible

	to discharge batteries periodically manually. Each rectifier bank shall have minimum 3 nos. rectifier modules for all applications. Each rectifier module shall be of minimum 10% rating of the total capacity for Control system loads. The exact sizing of the rectifiers in one bank shall be as approved by Employer during detailed engineering. Provision shall be available to add new modules in each rectifier cabinet for future use. While selecting the components and finalizing the cooling arrangements, Bidder to note that these rectifier modules are required to operate at 30-40 % of the rated load for most of the time.
9.02.03	The rectifier module shall be microprocessor controlled, IGBT/Power MOSFET based, high frequency with active load sharing, designed for single and parrel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimize harmonics. The rectifier module output regulation shall be +/- 1% or better from no load to full load with an input power supply variation of +/- 10% in voltage and +/- 5% in frequency. In addition to indications / display on rectifier panel, potential free contacts for alarms like O/P voltage high & low, battery isolated, multiple rectifier modules failed, AC input supply out of specified range, communication fault, battery fuse blown, surge protection failure, controller faulty but system running, system overload, etc. shall also be provided for use in PLC system. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier module voltage etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. RS 485 Port Modbus Protocol / Ethernet TCP / IP protocol for communication with control system shall also be provided. Necessary provision shall be done in PLC end also.
9.02.04	"Float / Boost" charge functions shall be provided with alarm / indications.
9.02.05	Each rectifier bank shall be rated for 100% load requirement and keep the connected battery full charged and one spare rectifier module.
9.02.06	The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it.
9.02.07	The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.
9.02.08	The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.
9.02.09	The rectifier module shall be fed from 415 V AC, 50 HZ, 3 phase, 3 wire system. The Bidder shall provide all required power cables & other accessories etc. from 415 V AC power supply system to his electrical power supply system.
9.02.10	The full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to +/- 0.5% of output voltage.

CLAUSE NO.	TECHNICAL REQUIREMENTS
9.02.111	The rectifier module design shall ensure that there is no component failure due to fluctuation of input supply or loss of supply and restoration. This feature shall be demonstrated during factory testing at various loads.
9.02.112	Bidder shall furnish the equipment complete in all respect along with rectifier module rating & voltage drop calculations, supporting curves / data etc.
9.02.13	The Controller shall be intelligent, microprocessor controlled for monitoring & control of rectifier modules with features viz. auto / manual battery discharge test, battery reserve time prediction, energy management, remote control, float / boost mode control etc.
9.02.14	All software as required for smooth operation and monitoring of rectifier modules in conjunction with controller & BHMS shall be provided by the Contractor.
9.03.00	**Batteries for PLC system**
9.03.01	The batteries for PLC systems shall be heavy duty Nickel – cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni–cd batteries shall confirm to IS: 10918. For sizing calculation, an aging factor of 0.8 and a temperature correction factor of 0.935 (based on temperature of 4 deg. C). Capacity factor shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. The system shall also be suitably designed to overcome any over voltage that may arise during low-load operation of the rectifier modules.
9.04.00	**DC DISTRIBUTION BOARD (DCDB)**
	Redundant DC feeders (one from each DCDB) shall supply each of the connected panels. From DCDB / panel to driver/load feeder shall be in scope of Bidder.The exact design, rating & number of feeders of the each redundant DCDB shall be as finalized during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.
~~9.05.00~~	~~**POWER SUPPLY FOR FIRE ALARM PANELS & REPEATER ALARM PANEL**~~
	One set of 24 V DC power supply system with battery back up of 12 hours to be provided for each fire alarm panel and repeater alarm panel .
10.00.00	**CONTROL CABINETS / PANELS / DESKS**
10.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with

CLAUSE NO.	TECHNICAL REQUIREMENTS
	blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.
10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering. (b.) Interior:- Same as above.
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable. As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
10.01.06	Refer Subsection Basic Design Criteria, Part B, Section VI for grounding requirements.
10.02.00	The mimic shall be configured on the OWS/CRTs and it shall be possible to control, monitor and operate the plant from the same.
10.03.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.04.00	**CONTROL DESK**
10.04.01	Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 19 mm thick wooden top shall be provided on the desk to keep the TFT monitors at top and computers inside. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal and vertical directions. PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure and same shall be decided during detailed engineering. ASCII Keyboard shall be capable of being pulled out through a tray.
10.04.02	The cabling / wiring between OWS & CPU'S, power supply cables etc. shall be aesthetically routed and concealed from view.
10.05.00	**FURNITURE**
	Chairs – Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back. Chair pedestal shall be made of 5mm thick MS plate covered with poly-propylene cladding.Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon.The exact details shall be finalized & approved by Employer during detailed engineering.
11.00.00	**ANNUNCIATION SYSTEM**
11.01.00	Only OWS / GIU based alarm system shall be provided with audio alarm facility (beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided.
11.02.00	The system shall display history of alarms in chronological order on any of the OWS / GIU. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalised during detailed engineering. The alarm display/report format shall be as approved by the Employer.
11.03.00	Facility of audio annunciation shall be provided in OWS / GIU upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation shall be provided.
11.04.00	At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels.