TELANGANA STATE POWER GENERATION CORPORATION LIMITED
(TSGENCO)

1X800 MW KOTHAGUDEM TPS STGAE-VII UNIT-12 - FGD SYSTEM PKG.

TECHNICAL SPECIFICATION
FOR
FRP COOLING TOWER

Specification No. : PE-TS-439-165-N001 (REV. 0)

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

	TITLE:	SPEC. NO.: **PE-TS-439-165-N001**
	TECHNICAL SPECIFICATION FRP COOLING TOWER	SECTION:
		SUB-SECTION:
		REV. NO. **0** DATE 03.06.2022
	SPECIFIC TECHNICAL REQUIREMENTS	SHEET 1 OF **1**

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THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

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Notes:

1) For detailed list of documents to be submitted by bidder in their technical offer, please refer cl. no. 6.00 of Section-IIA.

2) For detailed list of documents to be submitted by vendor after award of contract, please refer Datasheet-C of Section-IIA.

3) In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA - Specific Technical Requirements (Mechanical)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)
SUB-SECTION ID – Datasheet-A

	TITLE:	
	TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SPEC. NO.: **PE-TS-439-165-N001**
		SECTION: **IA**
		SUB-SECTION:
		REV. NO. **0** DATE 03.06.2022
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SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

TITLE:	SPEC. NO.: **PE-TS-439-165-N001**
TECHNICAL SPECIFICATION FRP COOLING TOWER	SECTION: **I**
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1.00 INTENT OF SPECIFICATION:

1.01 This specification is intended to cover the design, manufacture, inspection & testing at manufacturer's and/or his sub-vendor's works, properly packed to avoid any damage during transportation & long storage at site, transportation to site, assembly at site (if supplied in knocked down condition), erection & commissioning at site and performance testing at site of Induced draft type FRP Cooling Tower for **FGD system package, of following project** including complete Electrical and C&I as specified and as necessary:

1) 1x800 MW TSGENCO KOTHAGUDEM TPS STAGE-VII, UNIT#12 –FGD

The performance parameters and other particulars of Cooling Towers are detailed in Data Sheet-A.

2.00 SCOPE OF EQUIPMENTS & WORKS UNDER THIS SPECIFICATION:

The equipment and works to be provided under this specification shall be as detailed below and as indicated in relevant portion of enclosed documents.

The items not specifically mentioned but deemed necessary to make the cooling tower complete in all respects, as self-contained package for reliable and efficient operation shall also be deemed to have been included in the scope of the bidder. In case this is not clear to bidder, the bidder may seek clarifications to same, failing which the specification intent shall be binding on bidder.

The scope of supply/ works as a complete package includes complete works between the terminal points which are stated or unstated but required as per the system requirements except for items specifically mentioned in exclusion list of works. Scope of works includes preparation of design and drawings, obtaining necessary approvals, materials, execution as per latest codes, specification, best Engineering practices and to the satisfaction of BHEL/ Owner for all mechanical, architectural, structural, electrification etc. BHEL will not bear any liability for any extra work, which might not have been perceived by the bidder but functionally required. The cost of such work will be entirely borne by the bidder.

The bidder shall furnish list of items/ services not included in his scope, otherwise the complete package shall be deemed to be in bidder's scope & Purchaser's interpretation in this regard shall be final & binding on the bidder.

The brief scope of supply, services & works for Cooling tower, complete with all other equipment and accessories as mentioned herein after. It is not the intent to list all details herein; scope of supply listed is in brief.

Each Cooling Tower shall be complete with following:

2.01 Scope (Mechanical):

a) The cooling tower shall be induced draft type in FRP construction as per Data Sheet –A of Sub-Sec. ID of this volume. The air inlet design W.B. temperature will be as specified in the Data Sheet-A.

b) The cooling tower shall be provided with Cooling tower fan assembly complete with weather proof motor, drive shaft, lubrication system, gearbox (as applicable), couplings, coupling guards & weather proof canopy hood. The fan & all rotating parts shall be protected by guard.

c) Access ladder shall be provided for the cooling tower.

e) The cooling tower shall be provided with louvers, tower fills & fill supports, drifts eliminator including all supporting structures, fastening arrangements & accessories.

f) Strainer at water outlet, Bird screen on top of tower shall be provided for the cooling tower.

g) All necessary supports, hangers, base plates, foundation plates, anchor bolts, sleeves, inserts, bolts, nuts for all equipment supplied & as necessary for mounting the assembled cooling tower on civil foundation.

h) Counter flanges, bolts, nuts & gaskets for all piping connections in the scope of bidders and also at terminal points.

i) Bidder shall provide Stainless steel (304 grade) Ball-Float valve matching with make-up water line size (40NB).

j) Cooling tower structure shall be designed to withstand wind load as specified, per IS-875 part3 / as specified under End customer specification in this section IA.

k) Supply & application of final painting at site.

2.02 **Scope (Electrical):** shall be as per Sub-section IB & IIB of this volume.

2.03 **Scope (C & I):** shall be as per Sub-section IC & IIC of this volume.

2.04 The following are also included in bidder's scope:

a) One set of special tools & tackles required for maintenance of equipments & accessories in the cooling towers.

b) Various drawings, datasheets, calculation, test reports/ certificates, operation & maintenance manuals including "As built drawings" etc. as specified & as necessary.

c) Supply of first fill of lubricants for all equipments under this package including second fill/ replenishment as necessary after commissioning & handing over of the cooling tower.

d) Supply of Erection & commissioning spares on as required basis.

e) Scope of services shall include transportation of equipment & material to site, assembly at site (if supplied in knocked down condition), erection & commissioning at site and performance testing of cooling towers at site. Supply of all labour including supervision personnel, materials, erection tools & tackles etc. as necessary for expeditious execution of works etc. are also included in bidder's scope. It shall be the responsibility of the bidder to arrange all items at site required for the execution of complete job including erection, commissioning & Testing at site.

f) Recommended spares for 3 years operation – bidder to furnish list with item wised prices. These prices not to be included in the base price but to be furnished separately.

3.00 **Equipment & Services to be provided by Purchaser:**

a. Supply and erection of incoming hot water piping up to cooling tower Hot water inlet nozzle/flange outside cooling tower.

b. Complete civil works including CT basin.

c. Cold-water outlet, Make-up water, drain & overflow piping from/to cooling tower basin.

d. For Electrical and C&I refer Sub-Sections IB/ IIB and IC/IIC respectively enclosed herein.

e. For equipment(s) & material supplied by bidder to site, loading/unloading of material at site, storage at site & movement of material at site shall be provided by Purchaser.

4.00 **Successful bidder in the event of award of contract shall furnish the GA Drg of CT basin within 6 weeks of LOI date incorporating relevant dimensional details for all the major**

points like Foundation details of CT structure, overflow piping, drain piping, hot water inlet to CT, cold water outlet from CT and make-up water to CT.

5.00 The cooling tower shall comply with complete specification. In case of any conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

6.00 DRAWINGS, CURVES AND INFORMATION REQUIRED:

6.01 The following documents only shall be furnished by the bidder with his offer:

a) Compliance certificate duly signed and stamped (enclosed in Section III).
b) General arrangement drawing for cooling tower. (Only for reference purpose)
c) Guarantee Schedule duly signed and stamped (Format enclosed in Section III)
d) Technical deviation schedule ('NIL or NO DEVIATION" to be indicated in case of No Deviation (Format as per NIT).
e) Unpriced copy of the Price Schedule (indicating "Quoted" for the listed items).

Apart from above no other drgs./docs./datasheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.

Note: The GA drawing shall be only for reference purpose; same shall not be reviewed/ commented by purchaser at this stage and shall be subject to approval only during contract.

7.00 It is mandatory for the bidders to furnish along with the bid, the deviation(s), if any, whether major or minor in the '**Schedule of Deviations**' only. In the absence of the deviations listed in the '**Schedule of Deviations**', the offer shall be deemed to be in full conformity with the specification not withstanding anything else stated elsewhere in the offer, data sheets etc. **The hidden deviations or stated/ implied deviations in the offer shall not be acceptable and binding on the purchaser**.

8.00 PERFORMANCE GUARANTEES AND LIQUIDATED DAMAGES:

a) Performance testing of cooling tower shall be done to demonstrate the guaranteed cooling water temperature at rated duty point. The cold-water temperature as specified in the specification shall be guaranteed by bidder for the design conditions of Cooling Water flow, range, ambient WBT as specified.

In case the test cold-water temperature as determined from the PG test is higher than the predicted value (based on the performance curves). Owner reserves the right to reject the tower.
The successful bidder shall demonstrate the above guarantees during performance testing at site.

b) The bidder shall guarantee the following, apart from other performance guarantees of the complete package.
- Total Fan Power consumption (KW) per Cooling Tower, for the cooling tower fans at fan motor inlet terminals.

c) The successful bidder shall demonstrate the above guarantees during performance testing at site.

The liquidated damages at the rate specified in Datasheet-A for each one (1) KW power consumption or fraction thereof shall be levied in the event of failure of bidder demonstrating the respective guaranteed values of KW power consumption.

9.00 BID EVALUATION CRITERIA:

Fan Power Consumption (KW) and ACW Pumping Head (MWC):

a) Total Fan power consumption (KW) per Cooling Tower, for the cooling tower fans at fan motor inlet terminal indicated in Guarantee schedule by bidder shall not exceed the respective maximum limits specified in Data Sheets A. In the event of total fan power consumption (KW) offered being more than maximum limits specified in Data Sheets A, then for every KW difference in power consumption of fan, loading at the rate given in Data Sheet-A shall be considered.

b) Bidder shall submit the ACW pumping head (MWC) in his technical offer. Any offer with pumping head more than as specified in Data sheet- A will be summarily rejected.

c) No technical advantage shall be given to any bidder for total fan power consumption (KW) and ACW pumping head (MWC) offered less than maximum limits specified in Datasheet-A.

10.00 TERMINAL POINTS:

a) Mechanical: Hot Water Inlet Nozzle/Flange (outside cooling tower). (Matching Counter flange in bidder scope).
b) Electrical: Motor Terminal Box.
c) C&I: Junction Box/LCP.
d) Civil: Top of Basin Curb wall

11.00 Successful bidder in the event of award of contract shall furnish the drawings/ documents as listed in Data Sheet-C. Distribution of various documents & submission schedule shall be as per NIT.

12.00 Additional Dispatch Requirements:

MDCC after final inspection shall be provided to vendor subject to submission of following documents along with meeting the other requirements stated in NIT :-

a) List of items packed in each box with description & quantity.
b) Photograph of each box in open & closed condition.

Bidder to include handling instructions on Packed Box of each item & in Engineering drg/doc/O&M Manual and packing to be done in such a way to avoid damage of items in transit and long storage at site and same shall be approved during contract stage by BHEL/Customer.

13.00 Following to be complied by the bidder:

a. Supplier to submit detailed 'Bill of Material' (BoM) at the time of drawing/document submission after placement of PO. Each item of the BoM to be uniquely identified with item code no. or item serial no.
b. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BoM.
c. Supplier to give following undertaking in the BoM"
"The BoM provided herewith completes the scope (in content and intent) of material supply under PO no.----------, dated ----------.
Any additional material which may become necessary for the intended application of the supplied items(s)/package will be supplied free of cost in most reasonable time."

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

1X800 MW KOTHAGUDEM TPS FGD

FRP COOLING TOWER
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA

BHEL	TITLE: **ELECTRICAL EQUIPMENT SPECIFICATION FOR FRP COOLING TOWER** **1X800 MW KOTHAGUDEM TPS-FGD**	SPECIFICATION NO. VOLUME NO. : SECTION : **IB** REV NO. : **0** DATE: 31/5/2022 SHEET: 2 OF 34

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The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

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		VOLUME NO. :
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TECHNICAL SPECIFICATION

FOR

FRP COOLING TOWER

(ELECTRICAL PORTION)

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR FRP COOLING TOWER 1X800 MW KOTHAGUDEM FGD	SPECIFICATION NO.
		VOLUME NO. :
		SECTION : IB
		REV NO. : DATE :
		SHEET : 2 OF 3

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) Electrical load requirement for FRP COOLING TOWER.
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) 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
g) 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.
h) Motor shall meet minimum requirement of motor specification.
i) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implication.
j) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
k) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

2.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

2.2 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.

2.0 LIST OF ENCLOSURES :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Customer specification for LV Motors
c) General requirement of LV Motors

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR FRP COOLING TOWER 1X800 MW KOTHAGUDEM FGD	SPECIFICATION NO.
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d) QP for LV Motors
e) Data Sheet –A for LV Motors
f) Datasheet-C for LT motors
g) Electrical Load data format
h) BHEL cable listing format
i) Typical details of cable trays and accessories

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR REV-0, DATE: 25.03.2015

PACKAGE : COOLING TOWER FRP
SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT :

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) 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. Any other voltage level (AC/DC) required will be derived by the vendor. OR (DE to select the choice applicable for their project)) 415 V AC, 3 phase, 3 wire 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. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre Optic cables etc.	Vendor	Vendor	
6	Cabling material (Cable trays, accessories & cable tray supporting system)	Vendor	Vendor	1. Layout details between vendors supplied equipment & installation dwgs by vendor. 2. BHEL will provide cable trench/cable racks/cable padestals along with cabling material up to the terminal point approx. 10 m away from cooling tower. Further cabling (supply and E&C) shall be in vendor's scope.
7	Cable glands ,lugs, and bimetallic strip for equipment 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 and control cables.
[redacted]				

Shweta 25/03/15

25/3/15

PACKAGE : COOLING TOWER FRP

SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				[redacted]
[redacted]				
10	LV Motors with base plate and foundation hardware [redacted]	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
[redacted]				
[redacted]				
13	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
14	**Engineering activities** during detailed engineering stage, including those listed below: a. Electrical load data submission in PEM format b. Electrical equipment GA drawings and layout drawings c. Cable trench/ tray layout drawings d. Control & Instrumentation cable schedules showing routing details [including cables supplied by PEM for CT equipment]. e. [redacted] f. Cable termination/ interconnection details (diagram)/ Cable block diagram	Vendor	--	1. Documentation shall be submitted as per project schedule for BHEL/ customer approval. 2. Vendor shall be responsible for necessary coordination with BHEL for required engineering interfacing during contract stage. 3. Any approval required from electrical inspection authority for electrical equipment shall be arranged by vendor.

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PACKAGE : COOLING TOWER FRP

SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

Shweta
25/03/15

25/3/15

VOLUME: V-A

SECTION-II

TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS

CONTENT

VOLUME: V-A

SECTION-II

TECHNICAL SPECIFICATION FOR A.C. & D.C. MOTORS

1.00.00 **SCOPE**

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 **CODES & STANDARDS**

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:

i) IS-325

ii) IS-12615

iii) IEC-60034

3.00.00 **SERVICE CONDITIONS**

3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-

Motors up to 1500kW	-	600% subject to IS tolerance of plus 20%.
Motors above 1500kW	-	450% not subject to any positive tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.

5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.

b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.

6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.

6.07.00 **Motor Terminal Box**

6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor		Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	:	25 mm
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating			Conductor Size
Above	Up to		
-------	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

Rating			Cable Size
Above	Up to		
-------	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating			Cable Size
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).

ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000 V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.

7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner’s cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS: 7816 as routine test

d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

j. Test to diagnose rotor bar failure during manufacture.

k. Over speed test as routine test.

l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be Submitted with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write-up on forced lubrication system, if any

d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply		Description	Consumer
H.V. Supply		11000 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 44 kA symm. for 1 sec.	Motors 1500 kW & above
M.V. Supply		3300 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 40 kA symm. for 1 sec.	Motors 175 kW and Up to less than 1500 kW.
L.V. Supply	(i)	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW and below 175kW.
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heating , A.C supply for Control & protective devices.
D.C. Supply		220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242 Volt

1.0	Design ambient temperature	:	50 ºC
2.0	Maximum acceptable kW rating of LV motor	:	Below 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	As per Customer motor spec. (enclosed)
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	o Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.25 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 160kW
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per customer motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	IE3

- **Also detailed Customer spec. for Motors to be referred as enclosed with spec.**

	TITLE:	
	TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SPEC. NO.: **PE-TS-439-165-N001**
		SECTION: **IC**
		SUB-SECTION:
		REV. NO. **0** DATE 03.06.2022
	SPECIFIC TECHNICAL REQUIREMENTS	SHEET 1 OF **1**

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C & I)

	FRP-COOLING TOWER SYSTEM SPECIFICATION (KOTHGUDEM FGD PROJECT)	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

C&I SPECIFICATION
OF
FRP-COOLING TOWER SYSTEM

	FRP-COOLING TOWER SYSTEM SPECIFICATION (KOTHGUDEM FGD PROJECT)	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

1. FRP-Cooling tower system shall be operated from FGD-DCS (BHEL Scope) through operator work stations (OWS).

2. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

3. The following items shall be provided as minimum by bidder corresponding on its offered FRP Cooling tower design (if applicable):

i) Temp Elements with temp transmitters and Temp Gauges for each Gear box.
ii) Redundant level Switch for each of the gear box for lube oil level.
iii) Field junction box for each fan for termination of cables from level switch, temp element with temperature transmitter.

4. All integral control system for FRP-Cooling Tower System is in bidder's scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.

5. The bidder shall provide complete Instrumentation for control, monitoring and operation of entire FRP-Cooling tower. The requirements given 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.

6. The make/model of various instruments/items/systems shall be as per customer's 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 more stringent requirement as per interpretation of customer/BHEL shall prevail without any commercial implication.

7. Power supply derived for contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.

8. The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.

9. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook−up diagram of drives is included for reference. (as applicable)

10. All instruments shall be terminated on JB/LCP in field and both instruments and JB/LCP are in bidder scope. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be subject to customer/BHEL's approval during detailed engineering.

	FRP-COOLING TOWER SYSTEM SPECIFICATION (KOTHGUDEM FGD PROJECT)	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

11. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

12. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a “No deviation” certificate is to be furnished.

13. For instruments which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved during detail engineering.

14. All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material, suitable pressure class and same shall be in bidder’s scope.

15. Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification

Note: -

1. All equipment items shall be of latest design with proven track record.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

6.02.00 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

a) Stable in spite of temperature fluctuations.

b) Able to withstand high humidity.

c) Weather proof.

d) Dust proof.

e) Corrosion resistant.

f) Erosion resistant.

g) Able to withstand high vibration.

h) Easily accessible for operation & maintenance.

6.03.00 Parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.

6.04.00 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

6.05.00 Instrument Accuracy, Standard Scales and Ranges

6.05.01 Instrument Accuracy

Instruments shall meet the following general requirements.

a) Pressure measurement shall be linear with respect to the measured pressure.

b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy shall include the effect of errors in the differential head measuring device, square root converter and signal generator.

c) Level measurement shall be linear with respect to the measured level based on a water specific gravity of 1.00.

d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced.

6.05.02 Instrument Scale Displays

a) All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.

b) Pressure instrument shall have the unit suffixed with ‘a’ or ‘g’ to

indicate absolute or gauge pressure, respectively.

c) Scales and charts of all instruments shall have linear graduations

6.05.03 Instrument Ranges

Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.

6.06.00 Operability & Maintainability

6.06.01 The system shall be designed such that any 'single-failure' shall not lead to loss of availability of the plant, alteration in operating routine or degradation of performance. This shall be achieved by judicious introduction of redundancy at all critical levels. The plant operator remains totally transparent to 'single-failures'.

6.06.02 The system and operator interfaces / consoles shall be designed for the operation of the unit with minimum operational manpower deployment . Bidder shall ensure proper operability and also take into account protections to achieve no accidental maloperations .

6.06.03 The choice of hardware shall take into account sound maintainability principles and techniques and shall not be limited to the following:

a) Standardization of parts.

b) Minimum use for special tools.

c) Modular and hot replacement.

d) Logical grouping of functions.

e) Separate and non-interactive adjustability.

f) Malfunction identification facility through self-diagnostics.

g) Easy removal, replacement and repair.

h) Easy assembly and disassembly.

i) Fool-proof design to preclude improper mounting and installation.

j) Redundancy of critical parts.

k) Unique process equipment vis a vis hardware identifiability by assigning sub-racks / sub-rack sections to specific plant areas.

6.06.04 Intercommunications in between sub-racks and system termination cabinets and in between sub racks and other panels shall be made by prefabricated connectors and cables with mechanical latch.

6.06.05 Adequate test facility shall be incorporated in the design.

6.07.00 Established Reliability & Availability

6.07.01 The minimum target reliability of each component/module shall be established by taking into consideration its Mean time between failure (MTBF) and Mean time to repair (MTTR), so that availability of the complete system is assured for 99.7%.

6.07.02 In order to establish the target reliability Bidder shall perform necessary availability tests and burn-in tests for major systems. Surge protection for solid state systems, selection of proper materials, manufacturing processes, quality controlled components and parts, adequate derating of electronic components and parts shall be ensured to meet the reliability and life expectancy goals.

6.07.03 Continuous self-checking features shall be incorporated in system design with automatic transfer to healthy/redundant circuits to enhance the reliability of the complete system.

6.08.00 Security and Failure Philosophy

6.08.01 General

It is essential that interlock, protection, supervision and automatic control systems shall have high integrity. Control & Instrumentation system shall meet the following requirements:

a) No single failure shall cause failure of the control.

b) No single fault shall cause the protection system to operate spuriously or cause the protection system to become inoperative.

c) Grouping of the control functions into system blocks shall be such that failure of any one block will only partly degrade the overall system.

d) Control system shall be structured with redundancy so that no single failure within the control system can cause the failure of plant on duty and at the same time cause the standby plant to be unavailable.

e) Due to control system failure if a final control element or plant item does not respond then the control element shall go into a fail safe status.

f) Field wiring for contact interrogation or device control shall be protected such that a fault on the cable does not cause loss of more than a minimum tolerable functionality of the system.

6.08.02 Measurement , Control & Channel Redundancy

To meet the failure and self checking criteria for the control system, measurement redundancy shall be provided for all the critical parameters. Throughout the control system, the security and validity of signals are to be ensured based on the following design principles.

a) Where a plant measurement is to be duplicated or triplicated such signals shall be separately fed to the different input modules.

b) Signals, after due security and validity checking by means of voting, averaging, median, difference monitoring or similar technique shall be used for control functions.

c) Where duplicated measurements are used, provision shall be there for selecting any one as the duty signal. Continuous monitoring of difference between the signals shall be made.

d) For binary and analog inputs required for protection of SG , TG and major auxiliaries whose non availability may result in loss of generation triple sensing devices shall be provided . Binary and analog inputs , which are required for protection of more than one equipment as well as protection signals for important auxiliaries and HT drives etc. triple sensing devices shall be provided .Also other binary and analog inputs required for CLCS dual sensing devices shall be provided . However,for those binary and analog inputs which are also required for protection in addition to CLCS, triple sensing devices shall be provided.

e) Measurement system, CLCS and OLCS shall all be configured with redundancy at processor modules,communication modules, data bus and power supply modules.Triple redundancy shall be followed as described elsewhere in the specification.All servers shall be dual redundant.

f) Both CLCS & OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals.

g) Redundant sensors shall be provided for all control applications. For all closed loop controls (CLCS) triple redundant sensors shall be provided. This will include sensors provided for compensation also. Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall also be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided.Dual and Triple redundant sensors shall also be provided as described elsewhere in the specification.

h) Signals shall be verified against cable failure / non coincidence monitoring for critical trip signals for SG/TG/ all HT auxiliaries.

6.08.03 Redundancy in input / output modules

1. Redundancy

a) Redundancy in input / output modules for close loop control systems, open loop control system, protection, interlocking and sequential control shall be provided as follows:

i) Wherever redundant sensors are employed each sensor shall be wired to a separate input module so that even if one input module fails, the parameter will be available from the other input module.

ii) If only one sensor is provided then redundant input cards shall be provided and wired accordingly.

iii) Redundant output card shall be provided for the signals from

6.08.08 Design of outdoor enclosures shall be weather proof, dust-tight, drip-proof and shall take into account the environmental conditions.

6.08.09 Enclosures shall be adequately sized so that the maximum permissible temperature rise above 50 Deg C ambient is 10 Deg C (maximum).

6.08.10 Enclosures design shall also take into account greatest possible personnel safety.

6.09.00 Electrical Noise Control

6.09.01 Equipment furnished by Bidder shall incorporate necessary techniques to eliminate problems caused by electrical noise interferences and power line borne surges encountered in power plant environment. Equipment, which are vulnerable to electrical noise interference or surge shall be suitably immunized to eliminate possible problems.

6.09.02 Bidder shall be responsible for implementation of the shielding, input balancing, ripple filtration and grounding for field inputs to achieve installation with minimum noise coupling.

6.09.03 Radiated immunity test shall be in accordance to IEC 801.3.

6.10.00 Surge-Protection For Solid State Equipment

6.10.01 All solid-state equipment shall be able to withstand the surges inherent in a powerhouse environment. Equipment shall be designed to successfully withstand surges without damage to components and/or wiring on application of surge wave whose shape and characteristics are defined in ANSI publication C37.90-a (IEEE-472-1974) entitled "Guide for Surge Withstand Capability (SWC) Tests".

6.10.02 To immunize the system against surge, coupling free wheeling diodes, surge suppressors, opto / galvanic isolators shall be used as required.

6.11.00 Burn-In And Elevated Temperature Test

Solid-state equipment / system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.

6.12.00 Elevated Temperature Test

a) During the first 48 hours the ambient temperature shall be maintained at 50^{O} C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.

b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.

c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component /module shall be monitored. Temperature rise inside the cubicle shall not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

6.13.00 Burn in Test

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

6.14.00 Panels, Cubicles and Enclosures

6.15.00 General

a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.

b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the CRCA steel for UCP / backup panel and other panels/cabinets shall be as described in Section VII of this volume of the specification. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.

d) Panel /cabinet shall have eyebolt on top for lifting.

e) Mounting , wiring , powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder ,this shall include freeissue items furnished by Owner.

6.15.01 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

b) Two spray coats of epoxy primer urface shall be applied to all exterior and interior surfaces, each coat of primer urface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final

finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

i) Exterior : Opaline green shade 275 of IS: 5

ii) Interior - Brilliant Glossy White.

c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

6.15.02 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.

b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.

c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.

d) Internal wiring shall be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low mili volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.

f) All low-level signal cables shall be separately bundled from control cable.

g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

h) Shield wires shall be terminated on separately.

i) Common connections shall be limited to two wires per terminal.

j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.

k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will

impede the opening of covers or obstruct access to leads, terminals or devices.

l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

m) Panels /cabinets /desks shall be provided with removable gasketted cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

o) Wire sizes used for internal wiring shall not be lower than the followings :

Control wiring (switches, pushbuttons etc.)	: 1.5 Sq.mm
Power supply/receptacle /illumination wiring	: 2.5 sq. mm or higher as per load
4-20mA DC current and low voltage signal upto 48V DC	: 0.5 Sq. mm

p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

6.15.03 Grounding

a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.

b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.

d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.

e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.

f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

6.16.00 Panel / Cabinet/ Desk/ Enclosures / junction boxes & instruments Environmental Protections

a) Panels, cabinets, desks, distribution boxes, racks ,junction boxes, terminal boxes , instruments and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-32 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-65 with anticorrosion coating.
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.17.00 Terminal Blocks

All ternminal blocks shall be provided complete with all required accessories including .Each terminal shall have LED indication with fuses to indicate and isolate earth faults. Spring-loaded (Cage-clamp type) terminals shall be used for termination of instrumentation cables at field JBs, FTCs and local panels.

7.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Liter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: Mm /%
x)	Conductivity	: Siemens / cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

8.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

8.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

8.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

8.03.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards.

9.00.00 POWER SUPPLY SYSTEMS

9.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.

9.02.00 Type of power supply systems envisaged for the various C&I system including DDCMIS are as follows:

240V AC Redundant UPS system for C&I control & monitoring system including DDCMIS , HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS , AAQMS etc. and PLC / proprietary control and

15.00.00 **SENSOR REDUNDANCY**

15.01.00 Apart from redundancy criteria described elsewhere in the specification , the following requirement shall also be met

15.02.00 Two out of three measurements philosophy shall be adopted for all CLCS and Protection for reliability of operation. The control system shall select the median value for the normal control purpose. In case of deviation of one transmitter output from the other two, the same shall be automatically isolated and average output of the remaining transmitters shall be fed to the control and measurement system and the control loop in this case shall be maintained on auto, with an alarm on the operator's work station as well as on the engineer's station. In tation . In case of failure of the two remaining transmitters in circuit, deviation of one transmitter output is more than the preset limit compared to the other transmitter,there shall be automatic bump less transfer to manual and changeovers shall have suitable alarms in the operator's work station as well as engineer's station .

For signal compensations, separate signals from separate transmitters other than used for measurement & control shall be used.

For OLCS all sensors used for the protection shall be triple redundant All sensors for permissive and interlock shall be dual redundant.

1.03.00 Displacer Type Level Transmitters

1.	Type		:	Smart (HART Compatible)
2.	Stages of operation		:	Continuous
3.	Material		:	
4.	i.	Displacer		SS-316
5.	ii.	Suspension wire		SS-316
6.	iii.	Torque tube housing		SS
7.	iv.	Torque tube		Inconel
8.	v.	Displacer chamber		SS
9.	vi.	Transmitter Housing		SS
10.	Operating Voltage		:	24 V DC
11.	Transmission		:	Microprocessor based, 2-wire
12.	Output Signal		:	4-20 mA DC along with superimposed digital signal
13.	Static / overload		:	Maximum static pressure without

	pressure		permanent deformation or loss of accuracy
14.	Turn-down ratio	:	10 : 1 or better
15.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	:	IP-65
17.	Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	:	0 - 50 ^{O}C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2” Flanged
22.	Performance - Accuracy	:	$\pm$ 0.075 % of span or better
23.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½” NPT Glands e) Handheld calibrator
24.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

1.05.00 RADAR TYPE LEVEL MEASUREMENT

1.	Type	:	Smart (HART Compatible)
2.	Antenna	:	Co axial / guided wave radar /–Overspill protection
3.	Principle	:	TDR (Time Domain Reflectometry)
4.	Communication	:	Two wire 4-20mA DC with HART
5.	Environmental temperature	:	0 – 50 ºC
6.	Enclosure	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
7.	Calibration	:	a) Self calibration with internal reference
		:	b) Zero & Span calibration
8.	Process Connection	:	External cage mounting Flanged /screwed
9.	Electronic Housing	:	Epoxy painted Die-Cast aluminium

				alloy
	10.	Antenna / Flange assembly	:	316 SS or Hestalloy (as required)
	11.	Power supply	:	24 V DC
	12.	Output Indicator	:	LCD
	13.	Accuracy	:	5 mm or 0.1% of probe length
	14.	Accessories	:	a) Handheld calibrator
			:	b) Counter Flange, nuts, bolts, gaskets etc
			:	c) ½"NPT cable gland
			:	d) SS Nameplate
	15.	Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
	16.	Applications	:	Vessels under vacuum or low pressure applications, solid levels

1.06.00 ULTRASONIC LEVEL TRANSMITTER

	1.	Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
	2.	Operating Principle	:	Detection of reflected ultrasonic pulse
	3.	Output Signal	:	4-20 mA DC along with superimposed digital signal
	4.	Operating frequency	:	10 KHz to 50 KHz (typical)
	5.	Display	:	LCD
	6.	Temperature Compensation	:	Built in –Programmable
	7.	Power supply	:	24 V DC
	8.	Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

9.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
10.	Accuracy & Repeatability	:	0.15 % of span or better
11.	Resolution	:	0.1 % of span
12.	Operating temp.	:	Transmitter- 500 C and Sensor - 800 C
13.	MOC Sensor	:	SS-316/Body- PVC and Face – Polyurethene
14.	Mounting	:	4” Flanged/ 2” NPT for sensor and Transmitter on panel
15.	Accessories	:	a) Handheld calibrator b) Weather canopy for protection from direct sunlight and direct rain c) ½”NPT cable gland d) All mounting hardware (SS-316), Prefab cable e) SS Nameplate
16.	Diagnosis	:	On-line
17.	Status Indication	:	Power On, HI, HI-HI, Lo, LO-LO, Fault
18.	Output Contacts	:	2 SPDT, 230V, 5A
19.	Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
20.	Applications	:	Coal Bunker, Water Service etc.

1.07.00 ULTRASONIC FLOW TRANSMITTER

1.	Type	:	Ultrasonic – Clamp On
2.	Accuracy	:	+/- 1 % of reading
3.	Repeatability	:	+/- 0.3 % of reading
4.	Rangeability	:	400 : 1
5.	Output Signal	:	4-20 mA DC with HART
6.	Measured Parameter	:	Volumetric flow, Totalized flow and flow Velocity
7.	Display	:	LCD with internal Key Pad (Flow rate & Totalization)
8.	Power Supply	:	24 V DC (2 Wire)
9.	Enclosure	:	SS (IP- 68 – Submersible)
10.	Mounting	:	SS Chain or Strap
11.	Accessories		1. Handheld calibrator 2. ½"NPT cable gland 3. Transducer cable 4. All mounting hardware (SS-316) 5. SS Nameplate
12.	Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
13.	Applications	:	Plant water service

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

3.00.00 PROCESS ACTUATED SWITCHES

3.01.00 PRESSURE SWITCH

1.	Type	:	i. Piston for high pressure application ii. Bellow / Diaphragm for low pressure application
2.	Sensing element material	:	SS-316. All other wetted part SS316
3.	Case Material	:	SSt
4.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5.	Over range	:	150 % of maximum pressure
6.	Adjustments	:	a) Internal Set Point
		:	b) Differential adjustment
7.	End Connection	:	1/2" NPT bottom connected
8.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
9.	Switch Type	:	Snap acting, shock & vibration proof
10.	Terminal Block	:	Suitable for full ring lugs
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12.	Performance	:	a) Repeat accuracy ± 1.0%
		:	b) Accuracy of Setting Indication of ± 1.5%
13.	Ambient temperature	:	0 – 50 Deg.C

14.	Nameplate	:	Tag number, service engraved in SS tag plate
15.	Accessories	:	a) Silicon oil/ Flurolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications b) Snubbers for pulsating fluid applications c) Siphons for steam and hot water services d) Retention ring and screws for surface mounting e) 1/2" NPT 2 Valve SS-316 barstock manifold f) ½" NPT cable gland
16.	Applications	:	During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1.	Type	:	i. Piston for high pressure application ii. Bellow / Diaphragm for low pressure application
2.	Sensing element material	:	SS-316. All other wetted part SS316
3.	Case Material	:	SS
4.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5.	Over range	:	150 % of maximum pressure

6.	Adjustments	:	a) Internal Set Point
		:	b) Differential adjustment
7.	End Connection	:	1/2" NPT bottom/ back connected
8.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
9.	Switch Type	:	Snap acting, shock & vibration proof
10.	Terminal Block	:	Suitable for full ring lugs
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12.	Performance	:	a) Repeat accuracy ± 1.0% b) Accuracy of Setting Indication of ± 1.5%
13.	Ambient temperature	:	0 – 50 Deg.C
14.	Nameplate	:	Tag number, service engraved in SS tag plate
15.	Accessories	:	a) Silicon oil/ Flurolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications b) Snubbers for pulsating fluid applications c) Siphons for steam and hot water services d) Retention ring and screws for surface mounting e) 1/2” NPT 5 Valve SS-316 barstock manifold f) ½” NPT cable gland
16.	Applications	:	During Detail Engineering on Owner’s

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1.	Float material	:	SS-316	
2.	Wetted parts	:	SS-316	
3.	Float chamber	:	Stainless steel/Carbon steel, construction welded	
4.	Float chamber mounting	:	Side mounted	
5.	Fluid connection	:	Side – Side	
6.	Fluid connection size	:	1” ANSI RF Flange (rubber line, if required)	
7.	Drain	:	½ inch NPT with Plug	
8.	Pressure rating of chamber	:	Minimum 1.5 times of design pressure	
9.	Repeatability	:	+/- 1.5 mm or better	
10.	Switch housing	:	Stainless Steel	
11.	Switch housing type	:	IP- 65	
12.	Type of switch	:	Snap acting magnetically operated hermetically sealed	
13.	Switch configuration	:	2 SPDT (5A, 240 V AC, 0.5A, 220V DC)	
14.	Accessories	:	a)	Counter flange, nuts & bolts, suitable gasket etc.
			b)	Steel globe type drain valve
			c)	½”NPT cable gland

		d)	Stainless steel nameplate with alpha-numeric engraved for service and tag
15.	Application	:	During Detail Engineering on Owner's approval

3.05.00 RF LEVEL SWITCH

1.	Type	:	RADIO FREQUENCY
	Sensing probe		
2.	Material	:	SS-316
3.	Mounting	:	Threaded
4.	Application Temperature	:	250°C (Max.)
	Electronic Controller		
5.	Input Supply Voltage	:	240V AC ±10%, 50 Hz.
6.	Relay Output	:	2 SPDT (240V AC, 5A)
7.	Ambient Temperature	:	50 °C
8.	Enclosure Protection	:	IP-66
9.	Enclosure Housing	:	SS
10.	Local LED Indication	:	Normal Level Power On Alarm Level Probe Healthy
11.	Switching Repeatability	:	±0.5%
12.	Accessories	:	Co-axial cable for probe connection to controller SS Tag plate ½" NPT Cable Glands
13.	Application	:	Solid level

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

1.	Type	:	Conductivity discrimination
2.	Probe MOC	:	SS-316
3.	Mounting	:	Flanged on external cage
4.	Application Temperature	:	250°C (Max.)
5.	Test Pressure	:	Two times rated pressure

	6. Input Supply Voltage	:	240V AC ±10%, 50 Hz.
	7. Input	:	Four independent channel with selectable switching threshold for water conductivity
	8. Relay Output	:	2 SPDT (240V AC, 5A)
	9. Ambient Temperature	:	50 °C
	10. Enclosure Protection	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
	11. Enclosure Housing	:	SS
	12. Local LED Indication	:	HI,LO, HIGH-HIGH, LOW-LOW Power Fault
	13. Accessories	:	a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) ½" NPT Cable Glands f) SS Tag Plate
	14. Application	:	During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

	1. Type	:	Bimetallic or gas filled
	2. Sensing Element Material	:	SS-316
	3. Bulb Material	:	SS-316
	4. Capillary	:	Stainless Steel armored

5.	Movement Material	:	Stainless Steel
6.	Case material	:	Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
7..	Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8.	Over range Protection	:	120 %
9.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
11.	Switch type	:	Snap acting, shock and vibration-proof
12.	Adjustability	:	Internal Set point adjustable over span range
13.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length b) Case compensation
14.	Performance		
	a) Scale Accuracy	:	±1.0 % of full scale
	b) Repeatability	:	< 0.5 % of full range
	c) Response time	:	Less than 40 seconds with thermowell
15.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting
16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
17.	Accessories	:	Mounting accessories, ½" NPT cable gland
18.	Applications	:	During Detail Engineering on Owner's

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1.	Type	:	Bourdon/Bellows/Diaphragm
2.	Sensing & Socket	:	SS-316
3.	Movement Material	:	SS-316
4.	Case Material	:	Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5.	Dial Size	:	Generally 150 mm
6.	Scale	:	Black lettering on white in 270 O arc.
7.	Window	:	Shatterproof glass
8.	Range Selection	:	Normal process pressure: 50~70 % of range
9.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero
10.	Adjustment	:	For Zero adjustment (Micrometer screw external) For Range adjustment (Micrometer screw internal).
11.	Element Connection	:	Argon welding
12.	Process Connection	:	1/2" NPT (M) Bottom for local, back for panel mounting
13.	Performance	:	Accuracy of ± 1.0 % of span or better
14.	Operating ambient	:	0 - 50 ^{O}C
15.	Safety Feature	:	Blow out disc /diaphragm at the back
16.	Accessories	:	a) Snubbers for pulsating fluid application.discharge b) Stainless steel Diaphragm seals

		for corrosive/ viscous/ solid bearing or slurry type fluid applications
		c) 3-Way SS316 Gauge cock for pressure gauges
		d) 5-valve SS316 manifold from barstock for differential pressure gauge
		e) Siphons for steam and hot water services
17. Nameplate	:	Tag number, service engraved in stainless steel tag plate

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1.	Type	:	Reflex /Transparent	
2.	Material			
	Glass	:	Toughened borosilicate resistant to thermal shock	
	Body Material	:	~~Carbon Steel~~ Stainless Steel	
	Enclosure	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)	
3.	Integral cocks & valves/Fittings	:	i.	SS 316
4.		:	ii.	Rubber lined corrosion resistant stainless steel (for DM/RO service)
5.	Vessel Connection	:	ANSI Flanged SS316	
6.	Accessories	:	i.	Integral cocks
			ii.	Drain Valves
			iii.	Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
			iv.	Illuminating lamps, Mica shield as required
			v.	Calibrated scale
7.	Pressure rating	:	Twice the maximum working pressure	
8.	Temperature	:	300 ^{O} C	
9.	Other details	:	For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap.	

4.04.00 SLIGHT GLASS

1.	Type	:	Flap-type.
2.	End connection	:	Screwed / Flanged
3.	Material		
	a) Body	:	SS- 304
	b) Cover plate	:	SS- 304
	c) Indicator	:	SS- 316
4.	Sight Glass	:	Toughened Borosilicate
5.	Gasket	:	Neoprene
6.	Bolts & Nuts	:	High tensile steel.
7.	Hydraulic Test Pressure	:	1.5 times maximum working pressure
8.	Accessories	:	Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.

5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES

5.01.00 RESISTANCE TEMPERATURE DETECTOR

1.	Type		:	Platinum (Duplex), Ungrounded
2.	Platinum (Duplex), Ungrounded		:	100 ohm at 0 ^{O}C
3.	Base		:	Wound on ceramic (anti-inductive)
4.	Wiring		:	3 Wire
5.	Protecting Tube			
	a)	O.D.	:	6 mm
	b)	Material	:	SS-316, Seamless
	c)	Filling	:	Magnesium oxide (Purity above 99.4%).
6.	Response time		:	a) 15 sec. (bare).
				b) 30 sec. (with thermowell)
7.	Calibration		:	DIN 43760
8.	Accuracy		:	± 0.5%
9.	Head			
	a)	Type	:	IP-65 universal screwed type

	b)	Material	:	Stainless Steel
	c)	Terminal blocks	:	Nickel plated Brass-screw type / silver plated
	d)	Cable connection	:	½" NPT gland and grommet
	e)	Others	:	Terminal head cover with SS chain and suitable gasket. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
10.	Accessories		:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Thermowell (As specified below)
11.	Thermowell connection		:	½" NPT (M) or 150 RF Flanged
12.	Nameplate		:	Tag number, service engraved in stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1.	Type	:	a)	16 SWG wire of Chromel Alumel) (Type-K)
			b)	Duplex
			c)	Ungrounded
2.	Protecting Tube			
	a) O.D.	:	6 mm	
	b) Material	:	SS-316, Seamless	
	c) Filling	:	Magnesium oxide (Purity above 99.4%).	
3.	Response time	:	a)	< 20 seconds for measurement
			b)	< 10 seconds for control
4.	Accuracy	:	$\pm$ 1.1^0 C up to 300 ^{0} C & 0.4% of measured temperature range above 300 ^{0}C	
5.	Head			
	a) Type	:	IP-65 universal screwed type	
	b) Material	:	Stainless Steel	
	c) Terminal blocks	:	Nickel plated Brass-screw type / silver plated	
	d) Cable connection	:	½" NPT gland and grommet	
6.	e) Others	:	Terminal head cover with SS chain and suitable gasket.	

			Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
7.	Accessories	:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Thermowell (As specified below)
8.	Thermowell connection	:	½" NPT (M) or 150 RF Flanged
9.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1.	Type	:	Expansion type (Liquid filled system)
2.	Sensing Element Material	:	Bourdon – SS-316
3.	Bulb and Capillary Material	:	SS-316
4.	Capillary Tubing	:	Inner sheath - solid drawn Material copper tube Outer sheath - PVC tube
5.	Movement Materials	:	Stainless Steel / Direct Bourdon tip connection to pointer spindle
6.	Case Material	:	Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

				cover conforming to IP 65.
	7.	Dial size	:	150 mm
	8.	Scale	:	Black lettering on white background in 270 Deg.C arc
	9.	Over range protection	:	125 percent of FSD
	10.	Capillary Glanding	:	1/2" NPT(M) x compression fitting (SS) to suit capillary
	11.	Instrument Connection	:	Bottom connection for local mounting, back connection for panel mounting
	12.	Process Connection	:	½" NPT (M) or 150 RF Flanged
	13.	Extension Neck Length	:	50 mm
	14.	Compensation	:	a) Capillary compensation
	15.		:	b) Case compensation
	16.	Performance	:	a) Accuracy : + /- 1.0 percent of full scale Deflection
			:	b) Repeatability : Less than 0.5 percent of full range
			:	c) Response time: 15 seconds (max.).
	17.	Capillary length	:	3.0 meters (local) / 15.0 metres (local panel)
	18.	Other features	:	Shatter proof glass
	19.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	20.	Accessories	:	SS316 Thermowell

5.04.00 THERMOWELL

	1.	Material	:	SS-316
	2.	Manufacture	:	Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

1.04.00 TERMINAL BLOCKS

1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.

1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.

1.04.03 The characteristics of the terminal blocks shall be as follows.

i) High contact force, independent of conductor cross-section and large contact surface area.

ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.

iii) Inspection and maintenance free (resistant to thermal aging and vibration)

iv) Low and constant voltage drop

1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.

1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.

1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.

1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.

1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.

1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

1.04.11 Other requirements of the terminal blocks are as follows:

i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.

ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.

v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

1.05.00 GROUNDING

1.05.01 Separate Protective and Electronic system ground as required shall be provided.

1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.

1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.

4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**

4.01.00 GENERAL

4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.

4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.

4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.

4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.

4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.

4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging

4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.

4.01.08 Earth stud shall be furnished at rack for safety grounding.

4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)

4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.

4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.

4.02.03 2” NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.

4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.

4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.

4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.

4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2” NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.

4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations

4.03.00 LOCAL INSTRUMENT RACK (LIR)

4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

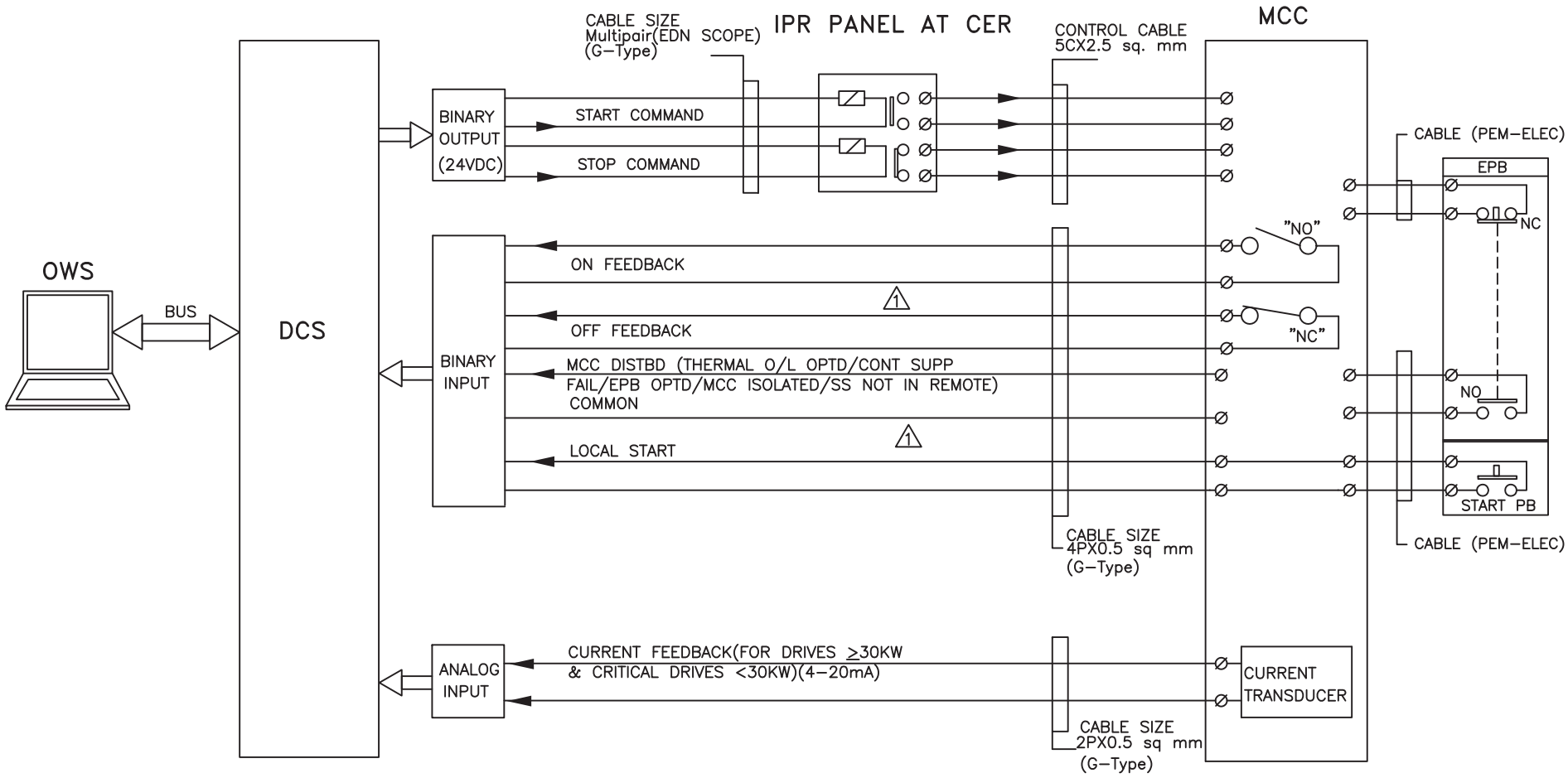
4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

1.	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
2.	Material	:	3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3.	Type of Cover	:	Solid unhinged with retention chain / Screwed at all four corners
4.	Paint	:	i) Exterior : Opaline green shade 275 of IS: 5 ii) Interior - Brilliant Glossy White.

			Surface / Two (2) inch Pipe stanchion
5.	Mounting	:	(At a dry compartment at one side of the enclosure / rack with front opening type door)
6.	Cable Entry	:	3 mm (min) Bottom / side Gland plate
7.	Gasket	:	Neoprene
8.	Grounding	:	Brass earth lug with green screw head External-2 nos , Internal-1no. (M6)
9.	Number of Drain Holes	:	Two at bottom capped
10.	Identification	:	Label for JB and Tags for cable
11.	Accessories	:	a) Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals b) Cable gland (Brass) & raceways c) Ferrules & lugs (Brass) d) Aluminum back panel e) Canopy at top f) Mounting brackets g) bolts and nuts made of brass etc.

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



* FOR LTUD DRIVES ALL LUBE OIL PUMPS, SCANNER AIR FANS, SEAL AIR FANS, 4–20mA CURRENT TRANSDUCER SHALL BE CONSIDERED.

BHEL Maharatna Company

PROJECT:	1X800 KOTHAGUDEM TPS STAGE–VII, UNIT–12	DRG.NO.	PE–DM–410–145–I002
		DATE	
TITLE:	DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	01
		SHT	8 OF 11

Instrumentation Quality Plan

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

	TITLE:	
	TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SPEC. NO.: **PE-TS-439-165-N001** SECTION: **I** SUB-SECTION: ID REV. NO. **0** DATE 03.06.2022 SHEET 1 OF **1**

SUB-SECTION – ID

DATA SHEET – A

DATA SHEET - A

FRP COOLING TOWER

		PROJECTS
		1x800 MW KOTHAGUDEM THERMAL POWER STATION STAGE-VII, UNIT-12 – FGD PROJECT
Sl. No.	**DESCRIPTION**	
1.0	**General Requirement**	
1.1	Type	Induced Draft Cooling Tower in FRP/GRP Construction , Counter or Cross Flow
1.2	Total number of Cooling Tower(s) for Project	1 (One)
1.3	Number of Cells per tower	To be decided by Bidder
1.4	Service	Cooling of Auxilairy cooling water (ACW)
1.5	Liquid Handled (refer water analysis enclosed herein)	Clarified water
1.6	Installation Location	Outdoor-Near ECW-ACW Pump House
1.7	Duty	Continuous
1.8	Specific gravity (liquid handled)	1
1.9	System Design pressure (kg/sq. cm), g	10
1.10	Mechanical Design Temperature (°C)	60
2.0	**DESIGN PERFORMANCE PARAMETERS FOR EACH COOLING TOWER**	
2.1	Design capacity (water flow rate total for each Tower), M^3/hr	200
2.2	Design Ambient air wet bulb temperature (Deg. C)	28
2.3	Design inlet air wet bulb temperature (Deg. C) (including re-circulation allowance)	28.4
2.4	Design Cooling Range (Deg. C)	5
2.5	Design Cold water temperature at Cooling Tower outlet (Deg. C)	33
2.6	Approach	4.6 degC w.r.t inlet WBT and 5 degC w.r.t Amb. WBT
2.7	Fan Motor rating	Continuous Motor rating (at 50 deg. C ambient) shall be at least Fifteen percent (15%) above the maximum power requirement of fan when the fan is operating at its test block condition as required at gear box input end.
2.8	Performance/Design Standard	ATC-105
2.9	Maximum permissible ACW Pumping Head (MWC) at design capacity (viz. Static lift from top of basin curb wall up to Centre of Hot water Inlet Pipe Nozzle/Flange of Cooling tower (including all loses).	4.0
2.10	Maximum limit on total power consumption per cooling tower for the cooling tower fans at fan motor inlet terminals (KW)	20.0
2.11	LD/Bid evaluation Rate on Auxiliary power consumption	INR 2.0 Lacs/KW
2.12	Gear Box Service factor	3 (minimum)
2.13	Factor of safety for drive shaft	2 (minimum) over the torque to be transmitted at design duty condition
3.0	**CONSTRUCTION FEATURES / ACCESSORIES**	
3.1	Basin (Common for all cells/Towers in case of multiple cells/Towers)	Purchaser scope (In RCC Construction)
3.2	Make up water connection	Purchaser scope
3.3	Drain connection with isolation valve.	Purchaser scope
3.4	Overflow connection	Purchaser scope
3.5	Access door in louvers/fan deck.	Bidder's scope
3.6	Internal Diameter of Distribution pipes	To suit max. design velocity of 2.0 m/sec
3.7	Valve (if applicable) & Size of Valve.	Bidder's scope (Same as that of pipe size, inlet pipe size 200NB)
3.8	SS Ball-float Valve & Size of Valve.	Bidder's scope (Same as that of make-up pipe size 40NB)
3.9	Supports & supporting structure	Bidder's scope

DATA SHEET - A

FRP COOLING TOWER

		PROJECTS
		1x800 MW KOTHAGUDEM THERMAL POWER STATION STAGE-VII, UNIT-12 – FGD PROJECT
Sl. No.	**DESCRIPTION**	
3.10	Canopy Rain protection for motor	Bidder's scope
3.11	Access Ladder	Bidder's scope
3.12	Suitable Guard for rotating parts	Bidder's scope
3.13	Strainer at water outlet	Bidder's scope
3.14	All necessary supports, hangers, Base plates, foundation plates, anchor bolts,sleeves, inserts, bolts, nuts for all equipments supplied.	Bidder's scope
4.0	**MATERIALS OF CONSTRUCTION**	
4.1	Casing/Body	Fibre Reinforced Plastic (FRP) /Glass reinforced plastic (GRP)
4.2	Fan	Cast Aluminum / FRP / GRP Propeller type and multi-blade aerofoil construction with adjustable pitch
4.3	Fan Hub	Heavily Galvanised M.Steel with SS hardware
4.4	Fan drive shaft & Coupling	SS-304
4.5	Gears	Alloy steel/equivalent
4.6	Fill	Non combustible PVC / Polypropylene (PP) or equivalent
4.7	Louvers	F.R.P. /PVC/ Aluminum.
4.8	Nozzles	Brass with chrome plating / Polypropylene / PVC
4.9	Drift Eliminators	PVC (UV Stablised), In removable sections to reduce the drift loss to 0.02% of water flow
4.10	Supporting structure	Mild steel with spray galvanization or epoxy painting
4.11	Access Ladder	Mild steel with spray galvanization or epoxy painting
4.12	Strainer at water outlet	Plate strainer made of GI/SS wire mesh of 16 gauge, basin outlet pipe size is 250NB
4.13	Bird screen on top of tower	25 mm square made of GI/SS wire mesh of 16 gauge
4.14	Distribution Pipe (if any)	Galvanised MS pipe/PVC/PP/FRP/GRP
4.15	Fasterners	Hot dip galvanized steel / SS
4.16	Wetted Fasterners	SS
4.17	Valve (if any)	Forged/cast carbon steel
4.18	Ball-float Valve	Stainless Steel Grade SS304
4.19	Connecting Pipe material (for deciding counterflange material)	Carbon Steel to IS 1239 (Heavy Grade) / IS:2062 GR. E 250B, Plates rolled & welded as per IS 3589.
5.0	**MANDATORY SPARES**	**NIL**
Notes :		
1	Material of construction for other components not specified above shall be similarly selected in line with the above for the duty intended and subject to approval.	
2	For items stated as not applicable by bidder, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.	
3	For Flanged end connections, matching counter flanges (complete with nuts,bolts,gaskets) will be in bidder's scope of supply. Flanges shall be as per ANSI B 16.5.	
4	Wherever SS material is coming in contact with non SS material, suitable isolation (rubber etc.) shall be provided to avoid galvanic corrosion.	
5	For every KW difference in power consumption of fan, loading at the rate given in Data Sheet-A shall be considered.	
6	Please refer Project information attached of Each project for other details/site conditions.	

ANNEXURE–II

TREATED WATER QUALITY

(DESIGN ANALYSIS OF CLARIFIED WATER)
[After addition of 50 ppm Alum, 20 ppm Lime ,1 ppm Polyelectrolyte and 5 ppm Chlorine on 100% purity basis)]

DESIGN ANALYSIS OF CLARIFIED WATER:

CONSTITUENTS	As	CONTENT	
Calcium	$CaCO_3$	128.9	ppm
Magnesium	$CaCO_3$	53.52	ppm
Sodium	$CaCO_3$	73.44	ppm
Potassium	$CaCO_3$	1.02	ppm
Iron in Soln.	Fe	0.1	ppm
Hydrogen (FMA)	$CaCO_3$	-	ppm
TOTAL CATIONS (except iron)	$CaCO_3$	256.88	ppm
Bicarbonate	$CaCO_3$	143.4	ppm
Carbonate	$CaCO_3$	0.53	ppm
Hydroxide	$CaCO_3$	0.02	ppm
Sulphate	$CaCO_3$	59.85	ppm
Chloride	$CaCO_3$	50.82	ppm
Nitrate	$CaCO_3$	1.21	ppm
Phosphate	$CaCO_3$	-	ppm
Fluoride	$CaCO_3$	1.05	ppm
TOTAL ANIONS	$CaCO_3$	256.88	ppm
Reactive Silica	SiO_2	10	ppm
Total Suspended Solid	CaCO3	10 ppm for normal condition	15 ppm (overload condition)
Conductivity at 25 deg C		450	Microsiemens/cm (max)
pH value at 25^0 C	-	7.62	
Turbidity		Not to exceed 15	NTU (max) 10 NTU for normal condition

Cycle of Concentration (COC) = 5

PROJECT SYNOPSIS AND GENERAL INFORMATION

CONTENT

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 SOURCE OF WATER

Source of water (total quantity of water is 2192 m^3/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 ASH DISPOSAL AREA

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL		:	89 m
Monthly highest temperature		:	44.9 ºC
Monthly lowest temperature.		:	12.9 ºC
Rainfall			
	Average.	:	1031 mm
	Max.	:	100 mm/ hr
Mean Wind speed		:	5.8 kmph
Relative Humidity			
	Max	:	82%
	Min	:	35%
Seismic Zone		:	Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].

WIND & SEISMIC LOADS FOR KOTHAGUDEM FGD

WIND LOAD

Wind loading will be in accordance with Indian Standard Code IS:875 (Part 3) for a basic wind speed of 44 m/sec. up to a height of 10 metres above mean ground level. Terrain Category-2, Class-C shall be considered for all structures. Risk coefficient (k1) shall be considered as 1.07 for all structures

SEISMIC LOADS

The site falls in Zone-III as identified in the map in IS:1893-2002. Analysis and design of structures to resist the seismic forces will be established in accordance with the recommendations of IS: 1893 (Part IV): 2005. Importance factor to be considered is 1.5 for all structures. Ductile detailing of RCC structures will be as per IS: 13920.

TITLE:	SPEC. NO.: **PE-TS-439-165-N001**
TECHNICAL SPECIFICATION FRP COOLING TOWER	SECTION: **II**
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SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR FRP CT

STANDARD QUALITY PLAN

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR FRP COOLING TOWERS	STD. SPECIFICATION NO. PE-TS-999-165-N051	
		SECTION : II	
		SUB-SECTION : IIA	
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1.0 GENERAL :

1.1 This standard specification covers the design, manufacture and assembly, inspection and testing at the Vendor's and/or his sub-vendor's works, suitable painting and packing, delivery & assembly at site, erection, commissioning and testing at site of all materials and equipments for mechanical induced draft Cooling tower complete with all accessories as specified hereinafter.

2.0 CODES AND STANDARD :

2.1 The design, manufacture, inspection and testing and performance of the Cooling Tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American Standards and Codes of practice. The latest editions of the following standards and publications shall be followed in particular.

a) Cooling Tower Institution of USA, Bulletin ATC-105 : Acceptance Test Code for Industrial Water Cooling tower.

b) PTC-23:ASME Performance Test Code for Atmospheric Water Cooling equipment.

c) For Electrical, C&I Codes/ Standards refer respective Specification.

d) BS-4485.

2.2 In case of any conflict between the above codes/ standards and this specification, the later shall prevail and in case any further conflict in the matter, the interpretation of the specification by the BHEL Engineer shall be final and binding.

3.0 DESIGN REQUIREMENTS :

3.1 The Cooling Tower shall be designed for continuous operation to cool not less than the design flow of water from specified inlet temperature to outlet temperature at a design ambient wet bulb temperature as indicated under Data Sheet-A enclosed to this specification.

3.2 All the components shall be capable of safe, proper and continuous operation at all cooling water flows upto and including those specified under Data Sheet-A and shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

3.3 The cooling tower shall be induced draft cross flow/ counter flow type having single or multiple cells. Number of cells in each cooling tower shall be as per enclosed Data Sheet-A.

3.4 The vendor under this specification shall assume full responsibility in proper design and operation of each and every component of the cooling tower as well as the cooling tower as a whole unit.

3.5 The Cooling tower shall be suitable for handling the fluid as per Data Sheet-A and also for achieving the specified parameters in Data Sheet-A.

3.6 The Cooling tower shall be designed such that the drift losses and the evaporation losses are limited to the values as specified in Data Sheet-A.

3.7 The Cooling Tower structure shall be of adequate strength to withstand the wind load and the effect of earthquake on the structure. Design wind pressure and horizontal/vertical seismic coefficient shall be taken as mentioned in the specification.

4.0 CONSTRUCTIONAL FEATURES :

4.1 Casing and Louvers :

4.1.1 The Louvers shall be designed for air entry to the tower with low velocity for minimum pressure drop and less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be along the base circumference of the casing & metal mesh shall be provided to protect the air intake.

4.1.2 The louvers and casing shall be made of material as specified in the Data Sheet-A.

4.2 Fill :

4.2.1 Cooling tower fills type and material shall be as specified in Data Sheet-A.

4.2.2 Design and arrangement of the fills shall be so as to expose high air/ water surface with low air pressure drop.

4.2.3 Fills shall be supported to minimise sag, possibility of dislodgement and damage to fill materials.

4.3 Drift Eliminators :

4.3.1 Multipass drift eliminators with minimum two pass zig zag path type shall be provided so as to limit the drift loss to that specified in Data Sheet-A. The drift eliminators shall be of multi-blade rotary type. The drift eliminators can also be of integral type with fills.

4.4 Hot Water Distribution System :

4.4.1 Hot water distribution system scope shall be as per Section I of this specification.

4.4.2 The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzle material shall be as specified in Data Sheet-A

4.4.3 The hot water distribution piping and valves shall be designed for the design pressure as indicated in the Data Sheet-A.

4.5 Cooling Tower Cold Water Basin :

4.5.1 Cooling tower basin scope shall be as per Section I of this specification. The cooling tower basin material of construction and basin storage capacity shall be as specified in Data Sheet-A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity with overflow & drain arrangement for safe operation of plant.

4.6 Fans & Accessories :

4.6.1 The fans shall be multiple blade, low speed, high efficiency, axial flow type located for each cell above the top deck level of the cooling tower and the blades shall be individually fastened to the fan hub.

4.6.2 The fan rotating assembly shall be statically balanced.

4.6.3 Each fan blade shall be adjustable as to the degree of pitch and shall be of the material as indicated in Data Sheet-A. It shall be possible to vary blade pitch angle.

4.6.4 Each fan may be driven through a speed reduction unit, specially designed for cooling tower service. The gear reducer shall be heavy duty, industrial design and shall adopt a service factor as specified in data Sheet-A, over fan rated BHP.

4.6.5 The KW rating of the drive motor shall have at least 15% margin over maximum fan power consumption (unless otherwise specified in Data Sheet-A). The design and construction of the drive motor shall be in accordance with the enclosed specification for LV motors.

4.6.6 The materials of fan drive shaft shall be as per Data Sheet-A and shall be specially designed for cooling tower service. Heavy duty flexible coupling with coupling guard shall be provided at shaft ends to compensate for operating misalignment alongwith supporting bearings for the drive shaft.

4.6.7 Each fan shall be provided with an oil level indication and antivibration cut out switch suitably wired and connected as a safety device. Contact rating of the vibration switch shall be furnished for approval of the purchaser. The vibration switch shall be one no per fan. Fan will shut down on high vibration. The noise level of the fan at rated pitch and speed shall not exceed 85 dB at 50 feet.

4.7.0 Screens in Cold Water Outlet :

4.7.1 The screens shall be provided as per Data Sheet-A.

4.8 Hardware :

4.8.1 All fasteners, nuts and washers etc used in the cooling tower which are coming in direct contact with water or humid air shall be made of stainless steel, all others nuts & bolts etc. shall be made of HDG steel (unless otherwise specified in Data Sheet-A).

4.9 Access :

4.9.1 A staircase paddle ladder shall be provided external to the cooling tower at one end of each cooling tower along with stairways, landings, handrails etc. as necessary to give safe and convenient access to the top deck from the ground level. Material of stair case shall be as per Data Sheet-A.

5.0 INSPECTION AND TESTING :

5.1 The inspection/ testing of cooling tower and its various components shall be as per the approved Quality Plans.

5.2 Hydrostatic test for the hot water distribution piping (as applicable) shall be conducted at site after complete erection. The test pressure and duration shall be as per Data Sheet-A.

6.0 PERFORMANCE GUARANTEE TEST AT SITE, TOLERANCE & PENALTIES:

6.1 The Cooling Tower as a whole shall be tested at site to check and ascertain that the performance meets the requirements of the specification. It is the responsibility of the vendor to conduct the performance test of the cooling tower and prove the specified parameters to the satisfaction of the purchaser. The test shall be witnessed by the purchaser/ customer's representative or both, for which 15 days clear notice will be given to purchaser by the vendor.

6.2 The performance test of the cooling tower shall be carried out in accordance with cooling tower Institute Bulletin No. ATC 105 Acceptance test for Industrial Cooling Tower.

The details of the proposed test procedure shall be submitted by the vendor sufficiently in advance of the commencement of test for the review and approval of the purchaser.

6.3 Necessary correction curves required for correcting the test results for any difference in test and guaranteed design condition, shall be furnished by the supplier for approval alongwith the proposed test procedure.

6.4 All testing and calibrating instruments required for the site performance test shall be arranged by the cooling tower supplier without any extra cost. All instruments used by the supplier shall be duly calibrated from a recognised Institution and the same is to be arranged by the supplier.

6.5 The performance test shall be carried out at site as specified and all defects shall be satisfactorily rectified within a time period decided by purchaser. No extra amount shall be charged to purchaser for such rectification. After rectification, retesting will be done in the presence of purchaser/ customer's representative without any extra cost to purchaser till satisfactory performance is achieved.

6.6 The vendor shall submit performance curves for the cooling tower showing variation in performance from the design duty point with change in approach to wet bulb temperature, cooling range, water loading of the tower. The guaranteed power consumption at the design duty of cooling tower shall also be given. If the total power consumption exceeds the guaranteed figure, the vendor shall pay penalty in the following manner.

6.7 No penalty is to be paid if the total power consumption does not exceed the guaranteed figure.

6.8 In case the power consumption measured at the motor input terminals exceeds the guaranteed figure, the vendor will pay to the purchaser liquidated damages as specified in Data Sheet-A.

6.9 The power consumption recorded during performance guarantee test at site shall be considered as actual consumption for computation of penalty as above.

6.10 If any defects are observed, the bidder shall rectify the same without extra cost to the purchaser. Even after rectification if the guaranteed performance is not achieved & performance parameters recorded at site exceeds the acceptable limits of purchaser, the purchaser has right to reject the whole cooling tower and the vendor shall refund the entire money paid to him together with any penalty levied otherwise.

7.0 TENDER EVALUATION :

The offer shall be evaluated as per clause Tender/Bid Evaluation specified in Section I & as stated in NIT.

8.0 SPECIAL CLEANING PROTECTION & PAINTING :

8.1 All equipment shall be neatly finished. All exposed surface shall be smooth and free from burrs/ projections.

8.2 The surface preparation shall be done either mechanically or chemically by one or more of the methods as given in IS-1477 (Part-I)

8.3 INSIDE SURFACE:

8.3.1 The inside surfaces of the metallic piping and the valves which are in contact with water and which are not made of stainless steel or other corrosion resistant materials shall be painted with coal tar based epoxy paint of approved make and quality over a coat of Zinc Chromate Primer.

8.4 OUTSIDE SURFACE:

8.4.1 The outside surfaces of the metallic piping and the valves which are in contact with water and which are not made of stainless steel or other corrosion resistant materials shall be painted with one coat of red oxide primer & coat of synthetic enamel paint of approved shade, make and quality.

8.4.2 Steel parts used for cooling tower construction shall be hot dip galvanised after shop fabrication and shall be coated with rust preventing paints as per approved painting schedule. Before painting galvanized surfaces -etch primer to be applied.

8.5 All parts shall be properly boxed, crated, packed & protected to avoid any damage during transportation and storage at site.

9.0 DRAWING AND DATA AFTER AWARD OF CONTRACT :

The vendor shall furnish drawings and other technical documents as given in Data Sheet-C, enclosed with the specification.

10.0 SPECIAL TOOLS & TACKLES :

Special tools & tackles, if any, shall be included in scope of supply by the vendor. A list giving description of such tools & tackles shall be furnished by vendor.

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DATASHEET-C

DATA / DOCUMENTS TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

1. General Arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works, showing extent of platforms, walk ways, handrails, access doors, staircase, etc. and the limits of scope of supply of electrical works and C&I.

2. General Arrangement and Sectional Assembly drawings pertaining to the following components of the Cooling Tower (as applicable):

   a) Tower fill with supporting arrangement.

   b) Drift eliminator installation and details.

   c) Complete hot water distribution system including flow regulating valves, distribution basin/ pipes and nozzles etc.

   d) Arrangement drawing of the cold water outlet piping incorporating also the arrangement of screens, valves and piping terminal details.

3. Technical datasheet as per Datasheet-B format (enclosed in section III).

4. Cooling tower performance curves showing wet bulb temperature V/s. cold water temperature for design cooling range, 90% cooling range and 110% cooling range at 90% ,100% and 110% of design flow.

5. Arrangement drawing of fan assembly drive shaft, fan hub and the gear reducer with materials of construction of different components.

6. Electrical and C&I drawings/documents/datasheets as mentioned in Electrical and C&I Sections/Sub-sections/Section-III of this specification.

7. Load data and calculation on civil works to enable preparation of Civil drawings & civil works by others at site:

   i) Design calculations for strength and suitability showing justification for size of members chosen for all structural components of cooling towers All structural design calculations shall be furnished by the supplier for review/approval of the purchaser.

ii) Load drawings setting out clearly and concisely the various loads taken into consideration for design.

iii) Insert details, anchor bolt, foundation bolts details.

iv) Final painting schedule.

v) Other drawings & data as necessary.

8. Cooling tower performance test procedure alongwith details of tests to be conducted for the offered cooling tower.

9. Quality Plan alongwith complete details of the testing and inspection requirements of mechanical, instrumentation and electrical items of the cooling tower in BHEL format.

10. Operation and Maintenance Manuals

11. Field Quality Plan for site activities – viz. Erection & commissioning.

12. Bidder to submit the Hard & soft copy of Approved/As-built drawings for distribution purpose as stated in NIT.

Note:

1) Drawing/document Submission schedule shall be as per NIT.

2) Drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays to bidder's account.

3) Before dispatch of the equipment(s), bidder shall furnish the other documents (viz. Material test certificates, Shop test reports, fulfilment of packing instructions etc.) as stated in NIT.

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	CUSTOMER :		QP NO.: PE-QP-999-165-N001	DATE: 26.07.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: FRP-INDUCED DRAFT COOLING TOWER	SYSTEM: ACW SYSTEM	SECTION:	SHEET – OF 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	**RAW MATERIAL**													
1.1	RESIN	GEL TIME, CHEMICAL PROP. SOLID CONTENT	MA	LAB TEST	1 PER BATCH		IS 6746	IS 6746	TEST CERTIFICATES	√	P	V		
1.2	GLASS FIBRE CLOTH	WEIGHT/UNIT LENGTH(Avg.)	MA	MEASUREMENT	1 PER BATCH		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST CERTIFICATES	√	P	V		
1.3	GALVANISED ITEM	COATING, ADHESION	MA	LAB TEST	IS 4759		IS 2629/IS 4759	IS 2629/IS 4759	TEST CERTIFICATES	√	P	V		
2.0	**BOUGHT OUT ITEMS**													
2.1	FAN BLADE	DIMENSION	MA	MEASUREMENT	100%		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	INSPN. REPORT	√	P	V		
		SURFACE DEFECTS	MA	VISUAL	100%		ASTM D 2563	ASTM D 2563	INSPN. REPORT	√	P	V		
		MECHANICAL PROPERTIES / CHEMICAL PROPERTIES	MA	LAB TEST	1 PER BATCH		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST CERTIFICATES	√	P	V		
2.2	HUB	DIMENSION	MA	MEASUREMENT	100%		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	INSPN. REPORT	√	P	V		
		SURFACE DEFECTS	MA	VISUAL	100%		ASTM D 2563	ASTM D 2563	INSPN. REPORT	√	P	V		
		MECHANICAL PROPERTIES / CHEMICAL PROPERTIES	MA	LAB TEST	1 PER BATCH		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST CERTIFICATES	√	P	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-165-N001	DATE: 26.07.2021
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	ITEM: FRP-INDUCED DRAFT COOLING TOWER	SYSTEM: ACW SYSTEM	SECTION:	SHEET – OF 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
2.3	NOZZLES	DIMENSIONAL	MA	MEASUREMENT	10% PER LOT		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	INSPN. REPORT	√	P	V		
		WORKMANSHIP & FINISH	MA	VISUAL	10% PER LOT		ASTM D 2563	ASTM D 2563	INSPN. REPORT	√	P	V		
2.4	FILLS, DRIFT ELIMINATOR & LOUVERS	DIMENSIONAL, COLOUR OF FILLS	MA	MEASUREMENT / VISUAL	10% PER LOT		MANUFACTURER'S STD.	MANUFACTURER'S STD.	INSPN. REPORT	√	P	V		
		WORKMANSHIP, FINISH	MA	VISUAL	10% PER LOT		ASTM D 2563	ASTM D 2563	INSPN. REPORT	√	P	V		
2.5	FASTENERS / HARDWARE	CHEMICAL PROPERTIES, MECHANICAL PROPERTIES	MA	CHEMICAL ANALYSIS / LAB TEST	1/LOT		APPD DRAWING / DATASHEET	APPD DRAWING / DATASHEET	TEST CERTIFICATES	√	P	V		
2.6	FASTENERS /HARDWARE	DIMENSION	MA	MEASUREMENT	IS 4759		APPD DRAWING / DATASHEET	APPD DRAWING / DATASHEET	TEST CERTIFICATES	√	P	V		
		WORKMANSHIP	MA	VISUAL	IS 4759		IS 2629/ IS 4759	IS 2629/ IS 4759	TEST CERTIFICATES	√	P	V		
		COATING ADHESION, MASS & UNIFORMITY	MA	LAB TEST	IS 4759		IS 2629	APPROVED DRG/DATASHEET	TEST CERTIFICATES	√	P	V		
2.7	PIPE (GALVANISED)	DIMENSION, WORKMANSHIP & FINISH, MECHANICAL, CHEMICAL & GALV. TEST	MA	VISUAL, DIM, & REVIEW OF TC FOR MECH & CHEM, GALV. CHECK (MASS OF COATING, UNIFORMITY, ADHESION)	IS : 1239 IS : 4759		IS: 1239 IS : 4759	IS: 1239 IS : 4759	TEST CERTIFICATES	√	P	V		

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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-165-N001	DATE: 26.07.2021
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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
3.0	**IN PROCESS INSPECTION**													
3.1	RESIN MIX	VISCOSITY	MA	VISCOSITY TEST	1 PER BATCH		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	INSPN. REPORT	√	P	V		
3.2	CASING & BASIN CURED FRP COMPONENT	OVERALL DIMENSIONS, THICKNESS	MA	MEASUREMENT	100%		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	INSPN. REPORT	√	P	V		
		WORKMANSHIP & FINISH	MA	VISUAL	100%		ASTM D 2563	ASTM D 2563	INSPN. REPORT	√	P	V		
3.3	HUB MACHINING	DIMENSIONS	MA	MEASUREMENT	100%		MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	INSPN. REPORT	√	P	V		
		WORKMANSHIP & FINISH	MA	VISUAL	100%		ASTM D 2563	ASTM D 2563	INSPN. REPORT	√	P	V		
		SURFACE DEFECT	MA	DP TEST	100%		ASTME 165	NO DEFECTS	INSPN. REPORT	√	P	V		
3.4	FAN ASSEMBLY	STATIC BALANCING, BLADE TIP CLEARANCE, BLADE TRACK VARIATION, OVERALL DIMENSION	CR	STATIC BALANCING. MEASUREMENT	100%		APPD DRG.	APPD DRG.	INSPN. REPORT	√	P	V		
3.5	GEAR BOX	VISUAL, CHEMICAL, MECHANICAL & DIMENSION	MA	MECHANICAL & CHEMICAL PROPERTIES/ MEASUREMENT/ VISUAL	100%		APPD. DWG / DATASHEET	APPD. DWG / DATASHEET	TEST CERTIFICATES	√	P	V		
3.6	GEAR MATCH SET													
3.7	GEAR CASE & COVER	VISUAL DIMENSION, MECHANICAL PROPERTIES / HARDNESS	MA	MECHANICAL & CHEMICAL PROPERTIES/ MEASUREMENT/ VISUAL	100%		APPD DRG /DATASHEET	APPD DRG /DATASHEET	INSPN. REPORT	√	P	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
3.8	FAN SHAFT	VISUAL, DIMENSION, MECHANICAL & CHEMICAL PROPERTIES	MA	MECHANICAL & CHEMICAL PROPERTIES/ MEASUREMENT/ VISUAL	100%		APPD DWG / DATASHEET	APPD DWG / DATASHEET	INSP. REPORT	√	P	V		(UT IS NOT APPLICABLE FOR DIA LESS THAN 50 MM)
		DPT AFTER MACHINING	MA	DP TEST	100%		ASTME-165	NO DEFECT	INSP. REPORT	√	P	V		
3.9	DRIVE SHAFT	VISUAL, DIMENSION, MECHANICAL & CHEMICAL PROPERTIES	MA	MECHANICAL & CHEMICAL PROPERTIES/ MEASUREMENT/ VISUAL	100%		APPD. DWG./ DATASHEET	APPD. DWG./ DATASHEET	INSP. REPORT	√	P	V		
4.0	DRIVE SHAFT ROD/PIPE	DPT FOR DRIVE SHAFT AFTER FINISHING MACHINING	MA	NDT	100%		ASTME-165	NO DEFECTS	INSP. REPORT	√	P	V		(UT IS NOT APPLICABLE FOR ROD/PIPE NB 50 MM AND BELOW)
4.1	DRIVE SHAFT YOKE	VISUAL, DIMENSION, MECHANICAL & CHEMICAL PROPERTIES	MA	MECHANICAL & CHEMICAL PROPERTIES/ MEASUREMENT/ VISUAL	100%		APPD DWG / DATASHEET	APPD DWG / DATASHEET	INSP. REPORT	√	P	V		
4.2	HDG STEEL FABRICATION (MECH. EQUIP, SUPPORTS & STEEL GRILLAGE)	DIMENSION & WORKMANSHIP	MA	VISUAL, MEASUREMENT	100%		APPD DWG / DATASHEET	APPD DWG / DATASHEET	INSP. REPORT	√	P	V		
		WELDING DEFECTS	MA	DP TEST	100%		ASTME-165	NO DEFECT	INSP. REPORT	√	P	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-165-N001	DATE: 26.07.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: FRP-INDUCED DRAFT COOLING TOWER	SYSTEM: ACW SYSTEM	SECTION:	SHEET – OF 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
5.0	**FINAL INSPECTION**													
5.1	GEAR REDUCER ASSEMBLY (GEAR BOX)	VISUAL & RUN TEST	MA	NOISE, BACK LASH, TORQUE LOAD TEST, OIL LEAKAGE & TEMPERATURE RISE	100%	100%	APPD DWG / DATASHEET	APPD DWG / DATASHEET	INSP. REPORT	√	P	W		1.ONE OF EACH TYPE SHALL BE WITNESSED BY BHEL.
5.2	MOTOR													Refer SQP of Motor
5.3	DRIVE SHAFT ASSEMBLY	VISUAL, DIMENSIONAL & DYNAMIC BALANCING	MA	VISUAL, /MEASUREMENT	100%	100%	APPD DWG / DATASHEET	APPD DWG / DATASHEET	INSP. REPORT	√	P	W		ONE OF EACH TYPE SHALL BE WITNESSED BY BHEL.
5.4	COMPLETE FAN ASSEMBLY	POWER CONSUMED, FAN EFFICIENCY, NOISE & VIBRATION	CR	RUN TEST	100%	1/TYPE/ SIZE	APPD DWG / DATASHEET/ATC-105	APPD DWG / DATASHEET/ATC-105	INSP. REPORT	√	P	W		ONE OF EACH TYPE SHALL BE WITNESSED BY BHEL.
5.5	PACKING	PACKING SOUNDNESS	MA	VISUAL	100%	100%	APPROVED PACKING PROCEDURE/ TECH. SPEC.	APPROVED PACKING PROCEDURE/ TECH. SPEC.	INSP. REPORT	√	P	W		
5.6	REVIEW OF QA DOCUMENTATION						AS PER APPD. QAP			√	P	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-165-N001	DATE: 26.07.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: FRP-INDUCED DRAFT COOLING TOWER	SYSTEM: ACW SYSTEM	SECTION:	SHEET – OF 6

NOTES :

(a) IN CASE OF FOREIGN SUPPLIER, ALL TEST CERTIFICATES SHALL BE FURNISHED BY THE SUPPLIER, DULY WITNESSED/VERIFIED BY BHEL's TPIA.

(b) FOLLOWING TO BE NOTED FOR PACKING:

MATERIAL SHALL BE PACKED SUITABLY IN ORDER TO AVOID DAMAGE DURING TRANSIT AND ALSO DURING STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

PHOTOGRAPHS OF THE PACKING JUST BEFORE DISPATCH FOR INFORMATION OF PEM.

(c) THE LATEST REVISIONS/YEAR OF ISSUE OF ALL THE STANDARDS SHALL BE REFERRED.

(d) BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.

(e) CHEMICAL AND MECHANICAL TESTS ON THE MATERIAL SHALL BE PERFORMED IN NABL ACCREDITED LABORATORIES.

(f) CALIBRATED INSTRUMENTS SHALL BE USED DURING INSPECTION, EXAMINATION AND TESTING.

(g) BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.

(h) IN ADDITION TO SHOP TESTS, PERFORMANCE TEST OF COMPLETE COOLING TOWER SHALL BE CARRIED OUT AT SITE AND VENDOR SHALL DEMONSTRATE THE GUARANTEED PARAMETERS AT SITE AS SPECIFIED IN THE SPECIFICATION.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL; **TPIA:** THIRD PARTY INSPECTION AGENCY

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
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Seal	

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Approved by:			

	TITLE:	
	TECHNICAL SPECIFICATION FRP COOLING TOWER	SPEC. NO.: **PE-TS-439-165-N001**
		SECTION: **II**
		SUB-SECTION: IIB
		REV. NO. **0** DATE 03.06.2022
		SHEET 1 OF **1**

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

BHEL	SYSTEM TITLE : **GENERAL TECHNICAL REQUIREMENTs** **FOR** **LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 1

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 for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating 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 for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for 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, mechanical 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 stated in 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 U 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.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:	Kunal Gandhi	KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
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	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
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		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	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	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

बी एच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:17.04.2020
		CUSTOMER :	QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
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					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR+HV-IR	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

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					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325/IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

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

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER 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, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM. **W**: WITNESS. **V**: VERIFICATION. AS APPROPRIATE

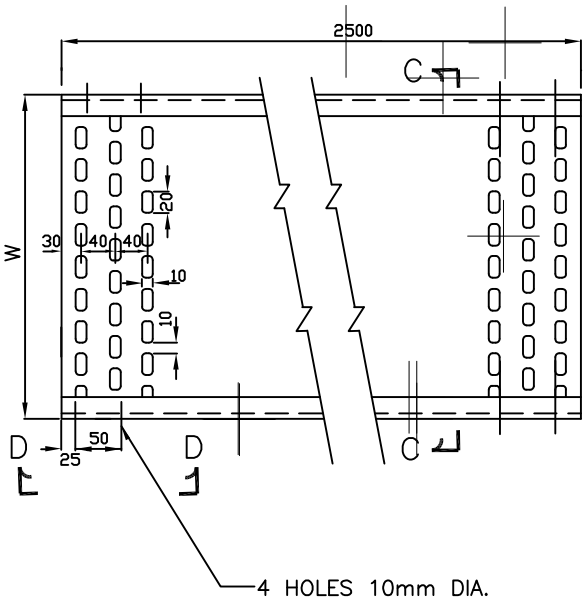
MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

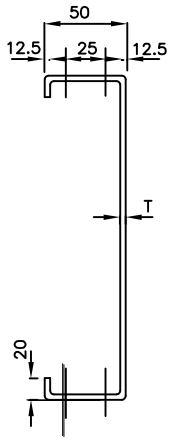
D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

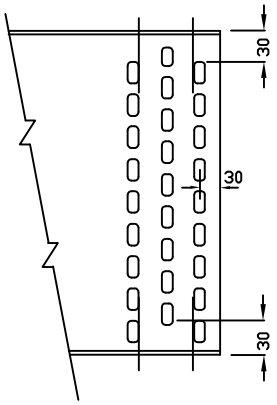
BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

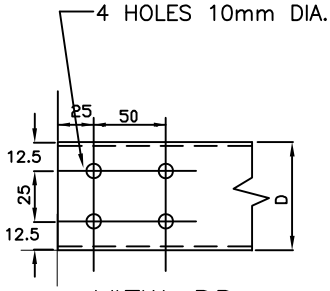




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

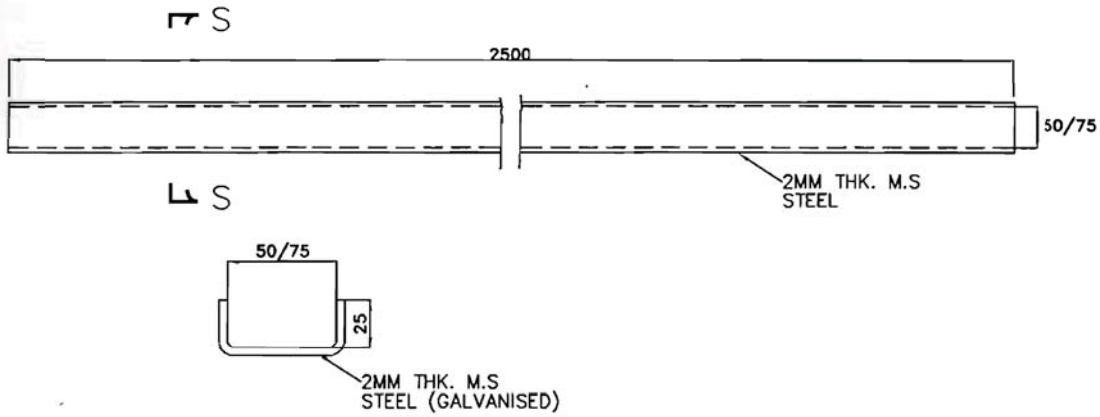


VIEW–DD
(100,50W TRAYS)

TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY

भेल BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SECTION S–S

CABLE TROUGHS

TYPICAL DETAILS OF CABLE TRAY AND ACCESSORIES	BHEL DRAWING NO.	
	SH OF	REV

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C & I)

BLANK / NOT USED

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

ALONG WITH TECHNICAL BID:

- **COMPLIANCE CERTIFICATE (ENCLOSED IN SECTION III)**
- **SCHEDULE OF PERFORMANCE GUARANTEE (FORMAT ATTACHED IN SECTION III)**
- **SCHEDULE OF DEVIATION (FORMAT AS PROVIDED IN NIT)**
- **UNPRICE SCHEDULE INDICATING 'QUOTED' AGAINST LIST OF ITEMS (FORMAT AS PROVIDED IN NIT)**
- **GA DRAWING FOR REFERENCE PURPOSE ONLY.**

AFTER AWARD OF CONTRACT:

- **DATASHEET-B (FORMAT ATTACHED IN SECTION III)**
- **MOTOR DATASHEET-C (FORMAT ATTACHED IN SECTION III)**
- **ELCTRICAL LOAD DATA (FORMAT ATTACHED IN SECTION III)**
- **CABLE SCHEDULE (FORMAT ATTACHED IN SECTION III)**
- **OTHER DRAWINGS/DOCUMENTS AS PER SPECIFICATION / NIT.**

	TECHNICAL SPECIFICATION FOR FRP COOLING TOWER 1x800 MW KOTHAGUDEM THERMAL POWER STATION STAGE-VII, UNIT#12-FGD	SPEC. NO.: **PE-TS-439-165-N001**
		SECTION: **III**
		REV. NO. **0** DATE **03.06.2022**
		SHEET **1** OF **1**

COMPLIANCE CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions with regard to same.

b) There are no other deviations w.r.t. specification other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.

d) All drawings etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The erection & commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself. Prices for special tools & tackles, if any, shall also be included in the base price.

g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.

h) The Performance guarantees shall stand valid till at least eighteen (18) months after full load commissioning of CT or as per commercial terms and conditions, whichever is later.

i) The hydrostatic testing of piping shall be carried out as specified i.e. at 1.5 times the design pressure.

j) All CT models offered have been supplied by bidder in the past and are meeting the experience qualifying criteria of BHEL/CONSULTANT/CUSTOMER (viz. offered model is successfully operating in two separate stations for at least one year or as specified in Technical PQR). Any deviation to this criteria shall be suitably highlighted in deviation schedule.

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

TITLE:	SPEC. NO.: **PE-TS-439-165-N001**
TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SECTION: **III**
	REV. NO. **0** DATE **03.06.2022**
SCHEDULE OF PERFORMANCE GUARANTEE **1X800 MW TSGENCO KOTHAGUDEM TPS, STAGE-VII, UNIT#12 - FGD SYSTEM PKG.**	SHEET **1** OF **1**

1.	Guaranteed Auxiliary Power consumption at inlet to motor terminals of Fan at design capacity & design condition	
1.1	Per Fan Motor:	KW :
1.2	Total for each Cooling tower, for all working cells per tower:	KW :
1.3	Total for 1 number Cooling tower for project :	KW :
2.	Guaranteed Cold water temperature at each Cooling tower Outlet at Design capacity & Parameters with the working cells	Deg. C :
3.	ACW Pumping Head (MWC) at design capacity (viz. Static lift from top of basin curb wall up to Centre of Hot water Inlet Pipe Nozzle/Flange of Cooling tower (including all loses)	MWC :

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE				
NAME	**DESIGNATION**	**SIGNATURE**	**DATE**	**COMPANY SEAL**

BHEL	**PROJECT:-**	Spec. No.: PE-TS-439-165-N001
	MECHANICAL INDUCED DRAUGHT FRP COOLING TOWER	Section III Rev. 00 Date :
	Title- DATA SHEET 'B'	Sheet 1 of 5

S.NO	ITEM	UNIT	PARTICULARS
1.0	**GENERAL INFORMATION**		
1.1	Tower manufacturer		
1.2	Tower model		
1.3	Tower type		
1.4	Quantity		
1.5	No. of cells (if applicable)		
1.6	Rated circulating water flow	M^3/hr	
1.7	Design wet bulb temperature (ambient)	°C	
1.8	Design inlet air W.B. temp. (considering recirculation)		
1.9	Design dry bulb temp.	°C	
1.10	Design cooling range	°C	
1.11	Design approach to ambient W.B. temperature	°C	
2.0	**PERFORMANCNE DATA**		
2.1	Evaporation loss (at design)	M^3/hr	
2.2	Maximum drift loss	M^3/hr	
2.3	Required pumping head including all losses measured at normal water level in the basin		
2.4	Cooling water flow (L) (kg/hr M^2 of fill area)	$Kg/hr/M^2$	
2.5	Ratio of water to air weights (L/G)	--	
2.6	Temperature of leaving air i. Dry bulb ii. Wet bulb	 °C °C	
2.7	Dry air flow (G) kg/hr M^2 of fill area	kg/hr M^2	
2.8	Dry air density	$kg/hr/M^3$	
2.9	Wet air density	$kg/hr/M^3$	
2.10	Dry air per fan	kg/hr	

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	PROJECT:-	Spec. No.: PE-TS-439-165-N001
BHEL	MECHANICAL INDUCED DRAUGHT FRP COOLING TOWER	Section III Rev. 00 Date :
	Title- DATA SHEET 'B'	Sheet 2 of 5

2.11	Total wet air per fan	kg/hr	
2.12	Heat transfer co-efficient	--	
2.13	Total fill volume	M^3	
2.14	Total vertical water fall height	M	
2.15	Gross louvered area	M^2	
3.0	**MATERIALS OF CONSTRUCTION**		
3.1	Casing		
3.2	Louvers		
3.3	Cell partition walls (if applicable)		
3.4	Basin partition walls		
3.5	Fan stack		
3.6	Top deck		
3.7	Ladder		
3.8	Hot water piping		
3.9	Hot water distribution basin		
3.10	Hand rail		
3.11	Supporting structure		
3.12	Structural connectors		
3.13	Bolts, nuts, washers and other hardware		
3.14	Nails, anchor bolts		
3.15	Hot water distribution nozzles and splash plates or rotary sprinkler as applicable.		
3.16	Mechanical equipment support.		
4.0	**DIMENSIONS**		
4.1	Tower dimension length x width	M	
4.2	Tower height from basin curb to fan deck	M	
4.3	Overall height including basin	M	

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	PROJECT:-	Spec. No.: PE-TS-439-165-N001
BHEL	MECHANICAL INDUCED DRAUGHT FRP COOLING TOWER	Section III Rev. 00 Date :
	Title- DATA SHEET 'B'	Sheet 3 of 5

4.4	Louver height and angle with horizontal	M degree	
4.5	Louver support distance	M	
4.6	Longitudinal partition provided?	Yes/No	
5.0	**HOT WATER SUPPLY**		
5.1	Nominal dia	M	
5.2	Center line height above basin curb	M	
5.3	Type of connection	--	
6.0	**TOWER BASIN**		
6.1	Height of basin curb from floor level	M	
6.2	Basin dimension i. Inside LXW ii. Outside LXW	 M M	
6.3	Maximum and minimum and normal water level with	M	
7.0	**FAN STACK**		
7.1	Height	M	
7.2	Elevation of top of fan stack from basin curb	M	
7.3	Diameter	M	
7.4	Exit air velocity at top of stack	M/sec	
7.5	Spacing of supports	Mm	
7.6	Fasteners – Material		
7.7	Type		
8.0	**DRIFT ELIMINATORS**		
8.1	No.of passes		
8.2	Cross face area per pass		
8.3	Type		
8.4	Material		

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	PROJECT:-	Spec. No.: PE-TS-439-165-N001
BHEL	MECHANICAL INDUCED DRAUGHT FRP COOLING TOWER	Section III Rev. 00 Date :
	Title- DATA SHEET 'B'	Sheet 4 of 5

8.5	Type of treatment (if applicable)		
8.6	Fasteners – material		
8.7	Type		
9.0	**FAN**		
9.1	Manufacturer		
9.2	Type		
9.3	Model No.		
9.4	Diameter	M	
9.5	No. of blades	--	
9.6	Blade tip clearance	--	
9.7	Fan speed	RPM	
9.8	Tip speed	M/sec	
9.9	Power consumption per fan	BHP	
9.10	Total static pressure	MMWG	
10.0	**FLOW CONTROL VALVE**		
10.1	Make		
10.2	Type and conformance to code in respect of design/testing		
10.3	Size		
10.4	Number offered		
11.0	**VALVES**		
11.1	Numbers offered		
11.2	Nominal size		
11.3	Type (rising/non rising spindle)		
11.4	Name of manufacturer		
11.5	Conforms to I.S		
11.6	Material of construction i. Body		

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

931024/2022/PS-PEM-MSE

	PROJECT:-	Spec. No.: PE-TS-439-165-N001
	MECHANICAL INDUCED DRAUGHT FRP COOLING TOWER	Section III Rev. 00 Date :
	Title- DATA SHEET 'B'	Sheet 5 of 5

	ii. Stem iii. Trim		
11.7	Type of connection (whether screwed/flanged etc)		
11.8	Test pressure	Kg/cm^2g	

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

TITLE	SPECIFICATION NO.
MOTOR	VOLUME II B
	SECTION D
DATA SHEET - C	REV NO. 00 DATE 31/5/2022
	SHEET 21 OF 34

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

TITLE	SPECIFICATION NO.
MOTOR	VOLUME II B
DATA SHEET - C	SECTION D
	REV NO. 00 DATE 31/5/2022
	SHEET 21 OF 34

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
																		ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	LOAD DATA (ELECTRICAL)	JOB NO.	440	ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE	1X800 MW KOTHAGUDEM TPS-FGD	NAME		DATA FILLED UP ON	
		SYSTEM	FRP COOLING TOWER	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MSE	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

6. Once a cable list has been given to PEM for routing, any subsequent changes required in the cable list (which may be in the form of addition of cables, deletion of cables, change of type or size of cable, etc.) must be informed as specific changes (as a separate file MS Excel of the same format as the original file) to the cable list given earlier if the cable list has been routed and cable schedule generated. The routing status of the cable list shall be got confirmed from PEM by the agency that has prepared the cable list before the changes are intimated. In case PEM confirms that the cable list in question has not been taken up for routing, and the revised cable list is acceptable, the same may be sent. Since cable routing through the program involves adding each cable list to the project cable schedule database, the original cable schedule shall not be furnished to PEM with revisions incorporated within.