TELANGANA STATE POWER GENERATION CORPORATION LTD.

1 X 800 MW KOTHAGUDAM FGD

TECHNICAL SPECIFICATION
FOR
ELECTRIC HOIST

SPECIFICATION NO.: PE-TS-439-563-A001

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

BHEL	**TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM FGD**	SPECIFICATION NO. PE-TS-439-563-A001
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SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

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BHEL	**TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM TPS- FGD**	SPECIFICATION NO. PE-TS-439-563-A001
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SUB-SECTION IA

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SCOPE OF ENQUIRY

1.1 The specification is intended to cover design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, fill of lubricants & consumables, mandatory spares along with spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site, along with Supervision of Erection and Commissioning at site for project and package specified complete with all accessories for the total scope defined for **ELECTRIC HOIST**

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply of ELECTRIC HOIST.**

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information , ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or TSGENCO including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

Note:
Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's Internal proxy setting should not block DMS application's link (https://www.bhelpem.com/WrenchWeb).

1.0.0 **SCOPE OF WORK**

1.1.0 **SUPPLIES**

1.1.1 Equipment and services to be furnished by the bidder for the **WIRE ROPE ELECTRIC HOIST** with accessories as per the details given in data sheet. Any equipment / accessories not specified in the specification but required to make the hoist units complete and efficient shall also be under the bidder's scope of work.

Each hoist shall include all necessary items but shall not be limited to the following: -

1. Travelling Trolley with drive arrangement.
2. Hoisting mechanism (motor and gear box, wire rope, load hook and hook block)
3. Electrical equipment (control panel, motor, limit switches, DSL current collector etc)
4. Cable for motor, brake, limit switches, etc.
5. Painting of hoist.
6. Power supply thru' DSL along with fixing brackets
7. Testing of hoist at manufacturers works.
8. Main isolating switch with earth fault protection and power cable from 1.5M above ground / operating floor upto DSL/junction box/terminal box.
9. Pendent push button with fixed type cabling
10. Initial fill of lubricants, grease etc.
11. Earthing arrangement
12. Any equipment / accessories not specified here but required to make the equipment complete and efficient shall be under bidder's scope of work.

1.1.2 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting in tropical climate. The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set**
2	Complete set of screwdrivers (Indicate the sizes)	1 Set**
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.

5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.

(**) – Set shall comprise of complete range of spanners suiting requirement for various capacities of electric hoists.

Note: - Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

1.1.3 Erection and commissioning spares.

Erection and commissioning spares, as deemed necessary by the bidder shall be supplied along with each Equipment. List of these commissioning spares shall be furnished by the bidder along with their offer. Any item not quoted by the bidder but found necessary during erection and commissioning shall have to be supplied by the bidder without any cost implication.

Sl no.	Description of equipment/item	Quantity
1	Overload Relay	1 set for each type of EH
2	Limit Switch	1 set for each type of EH
3	Fuse Link	1 set for each type of EH
4	Any other as per manufacture's recommendation	

N:B: One set shall mean 100% requirement for one electric hoist

1.1.4 Mandatory Spares -

A complete unused and new set of Mandatory Spare parts shall be supplied. Each part shall be stamped so as to be identified, easy for it use. The items supplied shall be of the best quality and specially protected against rusting in tropical climate. The minimum requirement of mandatory spare parts is listed in Annexure –II, Section IA of this specification.

1.2.0 Services to be provided by the bidder

1.2.1. Scope of work for delivery & transportation etc shall be as per commercial terms and conditions of NIT.

1.2.2. Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement. In case vendor submits revised drawing

after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion

1.2.3. Any other service mentioned in GCC & SCC as relevant to the package.

1.3.0 Inspection and Testing

Shall be as per manufacturing quality plan, drawings /documents approved during detail engineering and relevant IS codes. The standard manufacturing quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute the job. Procedure is indicated at Annexure IV, Volume IIB. The successful bidder has to follow the requirement in the above documents along with the relevant standards.

1.4.0 Drawing / design document for submission after award of contract

Drawing/ design documents to be submitted as per list & submission schedule attached as Annexure-V, section-II, volume II-B of this specification.

Any other design document/ drawing as required by customer/ BHEL shall be submitted by bidder during detail engineering without any implication.

1.5.0 Number of drawing and documents for submission

The number of prints / copies required for various drawing and documents are listed in Annexure –V, of GTR

1.6.0 Supervision of erection & commissioning: Bidders shall also be required to extend supervision of erection and commissioning of equipment's under the scope of supply of this specification on project to project basis (as per requirement). Rate on per visit and per man day basis shall be quoted in the price schedule. The actual no of days shall be informed on project to project basis, as and when required. Scope for charges per visit including service at site as per price schedule: Total lump sum price for visits should include travel expenses to & fro site, insurance (if applicable) & boarding and lodging etc for one day of stay at site including supervision charges for erection, commissioning, load testing or any other service at site. . Scope for charges for subsequent stay at site as per price schedule: shall include charges for supervision of erection, commissioning, load testing or any other service at site including boarding & lodging for subsequent stay at site. This shall be from the day of actual commencement of supervision at site/ availability at site for supervision activity, excluding travel time to & from site. These charges shall commence if the representative of vendor has to provide service at site beyond one day.

Note: Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert as deemed necessary by the bidder.

1.7.0 Surface Preparation, Painting & Colour Scheme

Detailed painting procedure has been attached as Annexure III, Section IA, Volume IIB. Bidder shall follow the same.

2.0.0. Works Excluded

2.1.0 Supply of ISMB monorail for electric hoist travel

2.2.0 Erection and Commissioning of electric hoists.

2.3.0 Purchaser shall provide single point 415V, 3 phase, and 50Hz power feeder at any point of the bay or in the middle of the bay. Vendor shall provide main isolating switch at 1.5 M above the ground / operating floor level and cable required from isolating switch to DSL.Any other supply required by the bidder shall be arranged by the bidder himself, using suitable transformer as per the specification.

3.0.0. **Deviations**

If the bid submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate “Schedule of Deviations” , given in General Condition of Contract (GCC), furnishing full particular of such deviations along with cost of withdrawal of deviation. Priced copy shall be submitted along with price schedule. Unpriced schedule shall be submitted along with technical offer. Unpriced format should contain “QUOTED” / “NIL” / “NA” against each deviation. Deviations are to be furnished with mention to specific clause number. Reasons / explanations for such deviations shall be furnished. If there are no deviations from the tender document, bidder shall furnish NO DEVIATION CERTIFICATE regarding the same.

4.0.0. **Demonstration Guarantee**

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder’s cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

5.0.0. **Make of Sub - Vendor items**

Make of bought out items will be as per Annexure-I, section IA, volume II-B of the specification. No other make will be acceptable, until and unless specifically got approved by BHEL/Customer during detail engineering. Acceptance/non acceptance of same shall not have any impact on manufacturing & delivery schedule and on cost of crane.

6.0.0 **Packing**

Refer General Technical Requirement.

7.0.0 **INFORMATION TO BE FURNISHED BY BIDDER ALONG WITH THE OFFER**

As detailed in “List of documents to be submitted with bid”, Section III

8.0.0 **OTHER REQUIREMENTS**

Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract along with supply of concerned equipment / component.

Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor’s account and shall not be used as a reason for extension in contract completion.

Annexure A:

S No.	Area/Equipment Description	Qty. (Nos.)	Capacity (T)	Lift (m)	Travel (m)
1	FGD Control Building	1	10 T	18	10.5
2	ACW PUMPS In clarified water PH	1	3 T	15	23

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QUALITY ASSURANCE PLAN

MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN			PROJECT	1 X 800 MW TSGENCO KOTHAGUDAM TPP
	ITEM: ELECTRIC WIRE ROPE HOIST	QP NO.		PACKAGE	ELECTRIC WIRE ROPE HOIST
		REV.		CONTRACT NO.	
		DATE		DATE	
		PAGE		CONTRACTOR	

SR. NO.	COMPONENT / OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9		10			11
1	RAW MATERIAL INSPECTION:-												
1.01	A) STRUCTURAL MATERIAL B) RAW MATERIAL FOR HOIST & GEARBOX HOUSING, TROLLEY PLATE(AS APPLICABLE)	CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL COMPOSITION & TENSILE STRENGTH	1/LOT	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	MILL.S TC	V	V	V	V	TEST SHALL BE CARRIED OUT IN ABSENCE OF MILL T.C
1.02	GEARS SHAFT/AXLES,WHEELS	CHEMICAL &MECHANICAL PROPERTIES	MA	CHEMICAL COMPOSITION, HARDNESS (DURING INPROCESS)	1/LOT	APPD. DRG./ DATA SHEET	APPD.DWG./ DATA SHEET	LAB.REPORT/ MANUFACTU-RER TEST CERTIFICATE	V	P	V	V	
		UT (ABOVE 50MM DIA./THICKNESS)	CR	NDT	100%	ASTMA 388	NOTE 4	INSPN. REPORT	V	P	V	V	
1.03	WIRE ROPE	DIMENSIONAL CHECK	MI	DIA.	100%	APPD. DRG./ DATA SHEET IS:2266	APPD. DRG./ DATA SHEET IS:2266	MANUFACTURER TEST CERTIFICATE	V	P	V	V	
		BREAKING LOAD CAPACITY	CR	BREAKING LOAD	100%	APPD. DRG./ DATA SHEET/ IS:2266	APPD. DRG./ DATA SHEET/ IS:2266	MANUFACTURER TEST CERTIFICATE	V	P	V	V	

CONTRACTOR

CTURE

LEGEND: * RECORDS IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. **M: MANUFACTURER/SUB-CONTRACTOR; C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL). N: CUSTOMER
INDICATE F: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE. "CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N" AS 'W'

REVIEWED BY

NAME & SIGNATURE OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN			PROJECT	1 X 800 MW TSGENCO KOTHAGUDAM TPP
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									D*	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
1.04	HOOKS	PHYS./CHEM., MECH. PROPS.	MA	CHEMICAL& MECHNICAL	100%	APPD. DRG. / DATA SHEET / IS:15560	APPD. DRG. / DATA SHEET / IS:15560	MANUFATURER TEST CERTIFICATE	V	P	V	V	
		U.T IF SHANK DIA >50MM	CR	NDT	100%	ASTM A 388	NOTE 2	INSPN. REPORT	V	P	V	V	SHANK PORTION ONLY
		PROOF LOAD CAPACITY	CR	PROOF LOAD TEST	100%	APPD. DRG. /DATA SHEET/ IS:15560	APPD. DRG./DATA SHEET/ IS:15560	INSPN. REPORT	V	P	V	V	
		DP AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	V	P	V	V	
		UT AFTER PROOF LOAD	CR	NDT	100%	ASTM A 388	NOTE 2	INSPN. REPORT	V	P	V	V	
2.0	IN-PROCESS												
2.01	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	SCRUTINY	100%	ASME SEC IX	ASME SEC IX	FORMAT OF IS / AS PER ASME SEC IX	V	P	V	V	Dyod/EIL/NPCIL/TPL approved WPS to be used. In case of NTPC/LLYODS/EIL/ TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED

ONTRACTOR

SIGNATURE

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1	2	3	4	5	6	7	8	9		10			11
2.02	PROCEDURE &WELDER QUALIFICATION	WELDING PARAMETERS	MA	PHYS. TESTS/RT	100%	IS:7310/ ASME SEC IX	IS:7310 / ASME SEC IX	AS PER ASME SEC IX	V	P	V	V	Liyod/EIL/NPCIL/TPL approved WPS to be used. In case of NTPC/LLYODS/EIL/ TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED.
2.03	WELD SET UPS	DIMENSIONS	MA	MEASUREMENT , VISUAL	100%	WPS, APPD. DRG.	WPS, APPD. DWG.	INSPN. REPORT	V	P	V	V	
2.04	WELDMENTS- FINAL RUN	SURFACE DEFECTS	MA	DPT For all welds	100%	ASTME:165	ASME Sec VIII Div 1 Cl UW 51 & 52 is for RT	INSPN. REPORT	V	P	V	V	
2.05	TRUNION / TROLLEY WHEELS,GEARS PINION	SURFACE & INTERNAL FLAWS (FOR DIA. /THICKNESS >50MM)	MA	PT/UT	100%	ASTMEC:165	NO LINEAR DEFECTS / NOTE -2	INSPN. REPORT	V	P	V	V	
2.06	ROPE DRUM	DIMENSIONS	MA	MEASUREMENT	100%	AS PER DRG.	AS PER DRG.	INSPN. REPORT	V	P	V	V	
		ROPE DRUM FILLET WELDING	MA	DPT	100%	ASTMEC:165	NO LINEAR DEFECTS / NOTE -2	INSPN. REPORT	V	P	V	V	
2.07	GEAR BOXES												
	COMPLETE ASSEMBELY	OVERALL	MA	MEASUREMENT	100%	MFG. DRG.	MFG. DRG.	INSPN. REPORT	V	P	V	V	

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SIGNATURE	REVIEWED BY	NAME & SIGNATURE OF APPROVING AUTHORITY & SEAL

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1	2	3	4	5	6	7	8	9		10			11
		DIMENSIONS											
		CHECK FOR OIL LEAKAGE, VIBRATION, NOISE, TEMP. RISE, BACKLASH & REDUCTION RATIO AFTER ASSY.	MA	NO LOAD RUNNING FOR FOUR HOURS	100%	MFG. DRG.	MFG. STD.	- DO -	V	P	V	V	
2.08	ELECTRICALS												
1	MOTORS	ROUTINE TESTS, TYPE,RATING, MAKE & SIZE	MA	ROUTINE TESTS	100%	IS:325 APPROVED GA/SCHEME/ SIZING	IS:325 APPROVED GA/SCHEME/ SIZING	MANUFACTUR-ER TEST CERTIFICATE	V	P	V	V	NOTE-1
2	RESISTANCE(IF APPLICABLE)	MAKE, TYPE, RATING,HV IR& FUNCTION TEST	MA	VERIFICATION OF MANUFACTURE TEST CERT.	100%	RELV. IS APPROVED GA/SCHEME/ SIZING	RELV. IS APPROVED GA/SCHEME/ SIZING	MANUFACTUR ER TEST CERTIFICATE	V	P	V	V	
3	CONTROLLER, LIMIT SWITCHES (IF APPLICABLE)	MAKE,TYPE, RATING,HV IR& FUNCTION TEST	MA	ROUTINE TESTS	100%	TECH. SPEC. APPROVED GA/SCHEME/ SIZING	TECH. SPEC. APPROVED GA/SCHEME/ SIZING	-	-	P	V	V	

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1	2	3	4	5	6	7	8	9		10			11
4	BRAKES	TYPE,MAKE,RATING,HV IR& FUNCTION TEST	MA	ROUTINE TESTS	100%	TECH. SPEC. APPROVED GA/SCHEME/ SIZING	TECH. SPEC. APPROVED GA/SCHEME/ SIZING	MANUFACTURER TEST CERTIFICATE	V	P	V	V	
6	CONTACTOR	TYPE,MAKE, RATING,HV IR& FUNCTION TEST	MA	RATING	100%	TECH. SPEC./ APPROVED SCHEME	TECH. SPEC./ APPROVED SCHEME	INSPN. REPORT	V	P	V	V	RATING & MAKE TO BE VERIFIED.
7	CONTROL PANEL, PENDENT SWITCH	FIXING OF COMPONENTS WIRING MARKING CONTINUITY *FUNCTIONAL TEST *IR & H.V. TEST *PAINT SHADE, THICKNESS, SHEET THICKNESS	MA	VISUAL	100%	APPD. DRG./ WIRING DIAGRAM	APPD. DRG./ WIRING DIAGRAM	INSPN. REPORT OF CONTROL PANEL	V	P	V	V	
8	CABLES	ROUTINE TESTS	MA	ROUTINE TESTS	100%	AS PER TECH. SPEC.	AS PER TECH. SPEC.	MANUFACTURER TEST CERT.	V	P	V	V	

MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	LEGEND: * RECORDS IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. "M: MANUFACTURER/SUB-CONTRACTOR; C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL), N: CUSTOMER INDICATE P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N" AS "W"		
SIGNATURE			REVIEWED BY	NAME & SIGNATURE OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN			PROJECT	1 X 800 MW TSGENCO KOTHAGUDAM TPP
	ITEM: ELECTRIC WIRE ROPE HOIST	QP NO.		PACKAGE	ELECTRIC WIRE ROPE HOIST
		REV.		CONTRACT NO.	
		DATE		DATE	
		PAGE		CONTRACTOR	BHEL

SR. NO.	COMPONENT / OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
3.0	FINAL INSPECTION												
3.01	COMPLETELY ASSEMBLED HOIST	COMPLETENCESS ,CORRECTNESS, OVERALL DIMENSIONS, HEAD ROOM	MA	VISUAL, MEASURMENT	100%	APPD. DRG.	APPD. DRG.	INSPN.REPORT	V	P	W	V	
3.02	ASSEMBLED HOIST PERFORMANCE OF COMPLETE ASSEMBLE HOIST WITH ACTUAL PANEL & PANDENT	1.LOAD TEST	CR	LOAD TEST AT SWL	100%	IS:3938	IS:3938	INSPN.REPORT	V	P	W	V	
		2.HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES, CONTACTORS, RELAYS & OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS & INTERLOCKS,SEQUENCE OF OPERTATION & FUNCTIONAL TEST	CR	MEASURMENT &VISUAL	100%	TECH. SPEC./ IS:3938	TECH. SPEC./ IS:3938	INSPN.REPORT	V	P	W	V	

CONTRACTOR

URE

LEGEND: * RECORDS IDENTIFIED WITH "TICK" (V) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. **M: MANUFACTURER/SUB-CONTRACTOR; C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL), N: CUSTOMER
INDICATE **P:** PERFORM **W:** WITNESS AND **V:** VERIFICATION, AS APPROPRIATE, "**CHP**" CUSTOMER SHALL IDENTIFY IN COLUMN "N" AS 'W'

REVIEWED BY

NAME & SIGNATURE OF APPROVING AUTHORITY & SEAL

बी एच ई एल BHEL	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN			PROJECT	1 X 800 MW TSGENCO KOTHAGUDAM TPP
		ITEM: ELECTRIC WIRE ROPE HOIST	QP NO.		PACKAGE	ELECTRIC WIRE ROPE HOIST
			REV.		CONTRACT NO.	
			DATE		DATE	
			PAGE		CONTRACTOR	BHEL

SR. NO.	COMPONENT / OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
		3.OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH. SPEC.	TECH. SPEC.	INSPN. REPORT	-	P	W	V	
3.03	OVER LOAD TEST	OVER LOAD, HOLDING CAPACITY OF BRAKES, LIMIT SWITCHES OPERATIONS	CR	TEST AT 125%OF SWL	100%	IS: 3938/ APPROVED DRG. /TECHNICAL SPEC.	IS: 3938/ APPROVED DRG. /TECHNICAL SPEC.	INSPN. REPORT	V	P	W	V	
4	PAINTING												
4.01	PRIMER & FINISHING & SHADE	EXAMINATION OF SHADE	MI	VISUAL	EACH CONSIGN MENT	DRG. & DATA SHEET & RELV. IS SPEC.	DRG. & DATA SHEET & RELV. IS SPEC.	INSPN. REPORT	-	P	V	-	

NOTE:-

1.0 Acceptance of motor less than 30KW is based on COC of the manufacturer & the contractor confirming as follows: It I s hereby confirmed that the above mentioned motor/motors was /were manufactured taking care of customer specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, Temp rise, distance between cenre of stud and gland plate and tested in accordance with approved drawing/data sheet.

2.0 Back wall echo shall be adjusted to 100% of full screen height in sound (defect free) area. Defect echo height more than 20% of screen height shall be treated as Unacceptable, back wall echo shall not be less than 80% of screen height in any case.

3.0 DCPL vide e-mail dtd.23/03/2015 ,confirmed that Sub-vendor list pertaining to particular Systems should be approved by BHEL. Hence Sub-vendor list for Single girder crane shall be approved by BHEL.

CONTRACTOR	LEGEND: * RECORDS IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. "M: MANUFACTURER/SUB-CONTRACTOR; C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL), N: CUSTOMER INDICATE P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE. "CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N" AS 'W'		
URE		REVIEWED BY	NAME & SIGNATURE OF APPROVING AUTHORITY & SEAL

	TECHNICAL SPECIFICATION FOR **ELECTRIC HOIST** **1X800 MW KOTHAGUDAM TPS- FGD**	SPECIFICATION NO. PE-TS-439-563-A001
		VOLUME II - B
		SECTION -I
		REV 00 / DATE JULY 2020

CUSTOMER SPECIFICATION

VOLUME : IIIF

SECTION-III

MISCELLANEOUS HOISTS

1.00.00 **GENERAL INFORMATION**

1.01.00 The hoists will be used for erection and maintenance of various equipment in different buildings.

1.02.00 Hoists are divided into two separate groups - (a) Hand operated and (b) Electric operated.

2.00.00 **CODES AND STANDARDS**

The design, manufacture and testing of the equipment covered under this specification shall conform to the latest editions of the following Indian Standards:

2.01.00	IS : 3832	:	Specification for Hand Operated Chain Pulley-blocks.
2.02.00	IS : 807	:	Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
2.03.00	IS : 6216	:	Short link Chain, Grade T(8) for Pulley-blocks & other Lifting Appliances.
2.04.00	IS : 4164	:	Lifting 'C' Hooks with Eye Capacity upto 25 tonnes.
2.05.00	IS : 2429 (part -I)	:	Non-calibrated Load Chain for Lifting Purposes.
2.06.00	IS : 3938	:	Specification for Electric Wire Rope Hoists. and other Indian Standards referred to in the above standards.

3.00.00 **SCOPE OF WORK**

3.01.00 Hoists shall be provided in all areas where any equipment/component weighing above 500 kg is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than 500 mm.

3.01.01 The location and no. of hoists is to be finalised during detailed engineering. Final arrangement is subject to approval of Owner/Consultant.

3.01.02 Monorail hoists shall at least be provided in the areas mentioned in Annexure-I. The list is indicative only and not an exhaustive one.

3.02.00 All drive motors and driving gears as necessary.

3.03.00 Limit switches for electrical hoist as necessary.

3.04.00 Trailing cable with all supporting fixtures as necessary for electric hoists.

3.05.00 Pendent control station with all accessories for electric hoists.

3.06.00 Lifting lug, eye bolts etc., for handling hoist parts.

3.07.00 Protection guard as specified.

3.08.00 Lifting hook block assembly for hoists.

4.00.00 **SPECIFIC DESIGN REQUIREMENTS**

4.01.00 Lifting capacity

4.01.01 Capacity of each hoist shall be 1.2 times the maximum working load.

4.01.02 Hoists of capacity upto 5 tones shall be manual hoists.

Hoists of capacity above 5 tones shall be electric hoists.

4.02.00 **Effort for Mechanical Hoists**

4.02.01 Hoisting

Hoisting effort for hoists upto 3 tones capacity shall not be more than 20 kg.

Hoisting effort for hoists above 3 tones capacity shall not be more than 25 kg

4.02.02 Trolley Motion

Effort for trolley motion for hoists upto 3 tones capacity shall not be more than 15 kg.

Effort for trolley motion for hoists above 3 tones capacity shall not be more than 20 Kg.

4.02.03 For Electric operated hoist both hoisting and trolley motion shall be motor operated.

4.03.00 **Lift**

4.03.01 Lift above operating floor

Highest position of the hook shall be such that during operation of hoists, the vertical distance between bottom of any equipment handled and top of any permanent structure or equipment in the operating area shall be at least one metre.

4.03.02 Approach below operating floor

To be decided by the Bidder for safe and reliable handling of any equipment above half ton below the operating floor.

4.04.00 **Length of Monorail Hoist**

To be decided by the Bidder depending on the floor and machine layout. The horizontal distance between the centre line of the hoist and centre line of any installed equipment in its operating shall not be more than half metre.

5.00.00 **DESIGN AND CONSTRUCTION**

5.01.00 All parts requiring replacement or lubrication shall be easily accessible without the need for dismantling of other equipment and structures.

Robust construction and ample rating merging which experience has shown to be necessary shall be ensured throughout manufacture.

5.02.00 All components of hoists of identical capacity and duty shall be interchangeable. The hoists of identical capacity and duty shall be identical in all respects unless otherwise required. The hoist design shall be such that these can be quickly removed from one monorail beam and fixed on another beam without disassembling major components.

5.03.00 All machinery and equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and specification requirements.

5.04.00 Cast iron parts wherever used, shall conform to IS:210 - FG 260. Also no wood or other combustible materials shall be used.

5.05.00 Defects in material like fractures, cracks, blowholes, laminations, pitting etc. are not allowed. Rectifications of any such flaw is permissible only with the approval of the Purchaser.

5.06.00 Each hoist shall be permanently and legibly stamped with the tag number, manufacturer's name, safe working load, grade of load chain (where applicable), range of lift etc.

5.07.00 Load chain (where applicable) shall be of grade T(8) as per IS:6216 and Hand chain shall be as per IS:2429 (Part-I) grade 30.

5.08.00 Wheels in trolley unit travel shall be single flanged with straight/tapper/barrel shaped tread to suit the monorail. Wheels should be preferably of forged steel construction. Material of construction for wheels of traversing block and hoist gear for hoist used in hazardous areas shall be of non-ferrous material to avoid spark during operation.

5.09.00 All gears shall be hardened and tempered steel with machine out teeth.

5.10.00 **Hoist (Manually Operated)**

5.10.01 Manually operated hoists shall be of spur gear chain pulley block type. It shall be suspended from the trolley by a hook. The design of the hoist shall conform to IS:3832 (Specification for hand operated chain pulley blocks). The hooks and brakes of hoist shall conform to the requirements stipulated in (a) and (b) below

a) Hooks shall conform to and IS:3832. The load hook shall be swievelling type fitted with a locking device.

b) The pulley blocks shall be fitted with an automatic mechanical load brake to prevent self lowering of load in all working positions. The load brake shall also allow smooth lowering of load without serious overheating.

c) All manually operated hoists, unless stated otherwise, shall be trolley suspended type.

5.10.02 The trolley of hoists shall be manually operated.

5.10.03 The hoists shall be of Mechanism class 2 as per IS:3832.

5.11.00 **Electric Hoist**

5.11.01 Electric hoist shall be electric wire rope trolley suspended type. The design, operation, testing of electric hoist shall conform to IS:3938 (Specification for electric wire rope hoist).

Minimum speed for hoisting shall be 3 m/min. and that of for trolley motion shall be 15 m/min.

5.11.02 Lifting hook shall conform to IS-4164 as applicable.

5.11.03 Wire rope for hoists shall conform to IS-2266.

5.11.04 Electro-mechanical brakes of fail to safety type shall be provided for hoist motion as well as per trolley motion for electrically driven trolley. Load brake shall allow smooth lowering of load and arrangement shall be such as it can not be released accidentally. Capacity of brake and other relevant data shall conform to IS:3938.

5.11.05 The trolley of the hoists shall be electrically driven.

5.11.06 For other components of hoist such as rope, sheave, drum, bearings, gears etc. stipulations of IS: 3938 shall be followed.

5.11.07 Motor shall be rated for duty S4. Service class of motor shall be "M8" as per IS:3177. Conditions given in IS:3938 for hoist motor shall be followed over and above the specification of electric motor in Volume-V. In case of any contradiction of the aforesaid standard and the motor specification, the conditions which are more stringent shall be considered. All the motors shall be suitable for reversing, frequent starting and braking. Motors shall be provided with suitable space heating arrangement.

5.11.08 Hoist shall be designed so that remote control can be effected by means of pendant push button switch from the operating floor. Operation, arrangement etc. of pendant push button switch shall conform to IS:3938.

5.11.09 Micro-speed attachment in hoist shall be provided if considered necessary by the Bidder.

5.11.10 The hoists shall be of mechanism class 2 as per IS-3938.

5.12.00 Ball and roller bearings of reputed make shall be used throughout.

5.13.00 Suitable lubrication system shall be provided for all gear drives.

5.14.00 **Other Electrical Items**

5.14.01 The cross conductor on monorail for power supply to the hoist shall be of festoon type flexible insulated cable conductors. All fixtures and accessories shall be provided by the Bidder for this purpose.

5.14.02 Necessary insulators, supports, clamps and all other accessories shall be provided as per standard design.

5.14.03 Each hoist shall be provided with a starter panel with protective relays.

5.14.04 One main isolating switch shall be used to cut-off the supply to the hoist assembly.

5.14.05 One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection panel.

5.14.06 The operation of overload relay shall interrupt the main magnetic contactor.

5.14.07 Adequate short circuit protection shall be provided for main and individual circuits.

5.14.08 415V ± 10%, 3 Phase, 4 Wire, 50 Hz ± 5%, power supply for the hoist shall be arranged through MCCB unit mounted at standing height at a convenient location near each hoist.

5.14.09 Transformers to step down the voltage and rectifiers as necessary shall be provided by the Bidder.

5.14.10 All external and internal power, control and auxiliary circuit wiring of the electrical drive and accessories and panels shall be provided. The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 sq.mm nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 sq.mm stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be furnished for terminating panel wiring and outgoing cable.

5.14.11 The hoist structure, motor frame and metal cases of all electrical equipment including metal conduit shall be effectively connected to earth. All grounding materials shall be supplied under this specification to grounding risers.

5.14.12 Single speed control shall be used for both hoist and trolley travel in each direction of motion.

6.00.00 **INSPECTION AND TESTING**

6.01.00 The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of the specification and in compliance with the requirements of the latest edition of IS:3832 or equivalent standards for manually operated hoists and shall be as per IS:3938 for electrically operated hoist.

6.02.00 All the mono-rail hoists shall also be tested at site as per the stipulation of relevant Indian Standards.

7.00.00 **DRAWINGS, DATA AND INFORMATION**

7.01.00 General arrangement drawings incorporating all dimensions information on head rooms, lift, wheel loads, hook suspension arrangement and other relevant data for all the hoists.

7.02.00 For Mandatory Spares, Spares required for erection and commissioning, Recommended Spares, Special Tools And Tackles, fixtures etc., as required for regular operation and maintenance of the equipment offered and supply of first charge of lubricating oil, inhibitor oil and also adequate quantity of the consumables, please refer Technical Specification Volume-II A.

7.03.00 Design calculation for selection of electric motor capacities for electric hoist.

7.04.00 Complete list of location, number and capacity of hoists provided.

	TECHNICAL SPECIFICATION FOR	SPECIFICATION NO. PE-TS-439-563-A001
	ELECTRIC HOIST	VOLUME II - B
	1X800 MW KOTHAGUDAM TPS- FGD	SECTION -I
		REV 00 / DATE JULY 2020

SUB-SECTION IB

SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)

BHEL	TECHNICAL SPECIFICATION FOR CRANES & HOISTS **(ELECTRICAL PORTION)**	

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

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 Cranes.
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) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) 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

3.1 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.

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

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Technical specification for motors.
c) Datasheets & quality plan for motors.
d) Electrical Load data format (Annexure –II)
e) BHEL cable listing format (Annexure –III)
f) Electrical mandatory spares (As per spec.)

REV: 00 DATE: 19.03.2015

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: **ELECTRIC HOISTS**

SCOPE OF VENDOR: SUPPLY

PROJECT : 1X800 MW KOTHAGUDEM TPS

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	Isolating Switch	Vendor	BHEL	BHEL will provide one number 415 V(3ph, 3W) supply feeder only up to isolating switches for cranes/ hoists. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane/ hoist control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	BHEL	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	BHEL	
4	Equipment Earthing	BHEL	BHEL	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL
5	Motors	Vendor	BHEL	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

TITLE		SPECIFICATION NO.
	LV MOTORS	VOLUME II B
		SECTION C
	DATA SHEET-A	REV NO. 00 DATE 19.03.2015
		SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	<175 KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55 - Outdoor IP54 – Indoor
5.0	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	:	25 kA for 1 sec
	e) Short time rating for terminal box	:	25 kA for 0.25 sec
	f) LV System grounding	:	Solidly
6.0	Class of insulation	:	Class 'F',with temp rise limited to class B.
7.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% of rated voltage
8.0	Power cables data	:	Shall be given during Detailed engg.
9.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
10.0	Space heater supply (30KW & ABOVE)	:	240 V, 1Φ , 50 Hz
11.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
12.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
13.0	Locked rotor current		
	a) Limit as percentage of FLC	:	600%
	b) Permissible tolerance, if any	:	±20%
14.0	Additional tests	:	As per QP
15.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
16.0	Makes	:	AS PER ANNUXURE-I
17.0	Terminal box	:	Suitable to rotate at 90 degrees
18.0	Paint shade	:	Shade 631 of IS-5

All LT motors shall be controlled as follows:
a) Up to 110kW: - Contactor operated.
b) 110Kw to 175kW shall have ACB.

CABLE SCHEDULE FORMAT

ANNEXURE III

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

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

	QUALITY PLAN	CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :					
		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :					
	SHEET 2 OF 2	SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-		

NOTES:

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

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

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

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

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

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

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 4 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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

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

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

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

BHEL	PARTICULARS	BIDDER/VENDOR	
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	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 7 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

BHEL	PARTICULARS	BIDDER/VENDOR	
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	SIGNATURE		
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	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 8 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	PARTICULARS	BIDDER/VENDOR	
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	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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

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 SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

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 240V, 1Ø, 2W, 50 Hz effectively earthed	Motors upto 0.2kW. 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

SECTION-IV

TECHNICAL SPECIFICATION
FOR
CABLES

1.00.00 **SCOPE OF SUPPLY**

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard.

Other cables including special cables, if any, which may be necessary as per proven engineering practice for satisfactory and trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

a)	11kV & 3.3 kV Power cables	:	Annexure - A
b)	1100V Power Cables	:	Annexure – B
c)	Control Cables	:	Annexure – C
d)	Fire Survival Cables	:	Annexure – D
e)	Flexible Trailing cable	:	Annexure – E

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 **CODES & STANDARDS**

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 **DESIGN CRITERIA**

3.01.00 Cables will be generally laid on ladder type trays or drawn through rigid PVC/GI /HDPE pipe/conduits. Cable tunnels shall be avoided as far as possible, except at locations where overhead trays are not possible, with prior approval of the Owner.

3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.

3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLSH) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.

3.06.00 Core identification for multicore cable shall be provided by colour coding.

3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **General Description**

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 **Drum Length and Tolerance**

The cables shall be supplied in non-returnable packing steel drum for 11 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm$5%.

4.03.00 **Non-Standard Length**

Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 **Cable identification**

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

a) TSGENCO

b) Manufacturer's name or trade mark

c) Voltage grade

d) Year of manufacture

e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.

f) No. of core and size of cables.

g) Type of improved fire performance, e.g. FR/FRLSH/FS

h) IS number

4.05.00 **Packing**

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

a) TSGENCO

b) Manufacturer's name or trade make

c) Type of cable & voltage grade

d) Year of manufacture

e) Type of insulation e.g. XLPE/HRPVC/IE2

f) No. of core and size of cables

g) Cable code e.g. FRLSH/FS

h) Length of cable on drum

i) No. of length on drum, if more than one

j) Direction of rotation, by arrow

k) Approx. gross mass.

l) IS/IEC number and ISI mark

4.06.00 **Joints and Terminations**

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 **Selection Criteria**

4.07.01 a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.

b) While sizing power cables, following aspects shall be reckoned:

i) Ground/Ambient Air temperature

ii) Depth of Laying.

iii) Power Cables touching each other.

c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time 0.16 Sec. for outgoing feeder, 0.5 Sec. for Tie feeder and 1.0 Sec. for Incomer.

d) HT cables shall be sized based on the following considerations:

Rated current of the equipment and ground/ambient temperature.

Touching/spacing of cable.

Laying on multi-tier racks, trench

Depth of laying.

The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. For BFP motor, the voltage drop during motor starting condition shall be limited to 20% and for Mill motor shall be limited to 10%. Other outgoing feeder / transformer feeder shall be limited to 3% rated voltage.

Short circuits withstand capability

e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered for loads fed from 415V PMCC. Incase of other out going line feeder voltage drop shall be limited to 3%.

f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.

g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.

h) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm^2 (3 core) & 16mm^2 (2 core) Cu - 2.5 mm^2

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, amp capacities, derating factors. as given in IS/IEC will be generally followed.

4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power Cable	:	240 Sq mm XLPE AL
3300V Power Cable	:	185 Sq mm XLPE AL
11000V Power Cable	:	240 Sq mm XLPE AL

b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

a)	Aluminium	:	6 Sq mm.
b)	Copper	:	2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-9/C

9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

a) Power.

b) Control, interlock and indication.

c) Metering and measuring.

d) Alarm and annunciation.

e) C.T. Cables.

f) V.T. Cables.

4.08.00 **Cable Identification**

Cable identification shall be provided by embossing on the outer sheath the following :

a) Manufacturer's name or trade mark

b) Manufacturer's name or trade mark

c) Voltage grade

d) Year of manufacture

e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.

f) No. of core & size of cables

g) Type of outer sheath e.g. FRLSH, FS etc.

4.09.00 Selected sizes of power and control cables are given in Annexure-G.

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended in Standard Technical Specification by CEA for the following services. The fire survival time of these cables shall not be less than 3 hours at 750 deg. C.

i. DC emergency lube oil pump

ii. DC hydrogen seal pump

iii. Turbine lube oil pump/barring gear

iv. DC emergency lighting for main building and service building

v. DC cables for battery to charger & DC distribution boards

vi. Jacking oil pump

vii. Emergency turbine trip in control room

viii. Boiler Turbine : Generator inter trip which include the interconnection between

- Boiler master fuel trip and turbine trip relays
- Generator trip relays & turbine trip relays
- Generator trip relays & generator breaker
- Generator trip relays & field breaker
- Generator trip relays & unit auxiliary transformer breaker
- Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below:

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.

5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 **Additional Tests**

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (category C1, Type FR/ Category C2, Type FRLSH)

5.02.01 Oxygen index test (both C1 & C2)

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test (both C1 & C2)

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.02.03 Flame Retardance test on single cable and on bunched cables (both C1 & C2)

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC-331

5.02.04 Halogen acid gas evolution test (for Category C2)

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test (for Category C2)

The cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for FS cable.

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-

a) Swedish Chimney test – SS: 424-14-75

b) IEEE std.383 – 1974 latest

c) IEC std. 332-1, 332-3 and IEC 331

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/ reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or

6.02.00 **To be submitted with the Bid**

a) Manufacturer's catalogues giving cable construction details and characteristics.

b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.

d) Type test reports on 11 KV & 3.3 KV Power, LT FRLSH Power & control, FS power and control cables.

e) Filled-up proposal particulars.

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

All relevant drawings and data pertaining to the equipment like GTP, QAP, etc. shall be submitted by the Bidder for the 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

RATINGS AND REQUIREMENTS
HV POWER CABLES (11 KV & 3.3 KV)

1.0 11000/11000V & 3300/3300V grade 90^0C continuous rating under normal condition and 250^0C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.

1.1	Conductor	:	Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
1.2	Conductor Screen	:	Extruded semi-conducting compound.
1.3	Insulation	:	Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
1.4	Insulation Screen	:	Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
1.5	Core Identification	:	By coloured strips applied on (For three core cables) cores.
1.6	Inner Sheath	:	Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
1.7	Armour	:	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
1.8	Overall Sheath	:	Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.9	Drum	:	Steel Drum

ANNEXURE-B

RATINGS AND REQUIREMENTS
LV POWER CABLES [1.1KV (XLPE TYPE)]

1.0 1100 V grade, 90ºC continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.

1.1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm^2 conforming to IS:8130.
1.2	Insulation	:	Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
1.3	Core Identification	:	By color coding
1.4	Inner Sheath	:	Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
1.5	Armour	:	Galvanized single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
1.6	Overall Sheath	:	Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.7	Drum	:	Conforming to IS-10418 (Wooden drum)

ANNEXURE-C

RATINGS AND REQUIREMENTS
CONTROL CABLES

1.0 1100 V grade 85ºC continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

1.1	Conductor	:	Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
1.2	Insulation	:	Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5 x 10^{14} ohm-cm at 27^{O}C and 3.5 x 10^{11} OHM-CM at 85^{O}C.
1.3	Core Identification	:	By color coding and numbering at interval of 100mm or less
1.4	Inner sheath	:	Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
1.5	Armour	:	Galvanised single round steel wire for twin and multicore cables.
1.6	Overall sheath	:	Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.7	Drum	:	Conforming to IS: 10418 (Wooden drum)

ANNEXURE-D

RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 750 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 750 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

ANNEXURE-E

RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES

i) 3300 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.

ANNEXURE-F

CABLE SIZES

Following sizes are given as a general guideline. Standard sizes as per IEC/IS shall be adopted.

Sl. No.	Cable Size	Conductor	Insulation
1.0	**H. T. CABLES (11kV)**		
1.1	1 core 1000 sq.mm	AL	XLPE (FRLS)
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	**H. T. CABLES (3.3kV)**		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	**L. T. POWER CABLES**		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.3	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.4	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.6	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.7	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 70 Sq.mm	AL	XLPE (FRLS)

Sl. No.	Cable Size	Conductor	Insulation
2.9	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.11	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.18	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	**CONTROL CABLE**		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	**FS POWER CABLES**		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	**FS CONTROL CABLE**		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR

	TECHNICAL SPECIFICATION FOR **ELECTRIC HOIST** **1X800 MW KOTHAGUDAM-FGD**	SPECIFICATION NO. PE-TS-439-563-A001
		VOLUME - IIB
		E IO – I / UB- E IO – I
		REV 00 / DATE JULY 2020

SUB-SECTION - IC
DATA SHEET-A

	TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM-FGD	SPECIFICATION NO. PE-TS-439-563-A001	
		VOLUME - IIB	
		E IO – I	UB- E IO – I
		REV 00	DATE JULY 2020

A.0.0 **TECHNICAL DATA SHEET OF ELECTRIC HOIST**

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As per Annexure A, sec I, Vol-IIB
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest
6.1	Design standards	IS: 3938, IS: 2266,IS: 4029, IS: 900,IS: 4237, IS: 694, IS: 3043, IS: 1822, IS: 2147. IS: 1554, IS: 325, IS: 15660, IS 9968 Part I etc as per latest revision
6.2	Duty class	Class II duty
7.0	Operating speed	
7.1	Hoisting speed	3 MPM.
7.2	Trolley speed	15 MPM
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 X 36 Steel core
9.2	Code	IS:2266
9.3	Number of falls	Min. 4
9.4	Factor of safety	5
10.0	Load Hook and block	NORMALISED HOOK ONLY
10.1	Type of load hook	Forged steel to IS 15560 C shank, swiveling type with safety Latch and pin.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	Alloy steel/carbon steel as per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
11.0	Gearing	
11.1	Type	Spur / Helical, hardened and tempered with machine cut teeth
11.2	Gear/ pinion material	Forged Steel as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller

12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938
12.3	Wheel material	Heat treated carbon steel/ low alloy steel (Max hardness 200 BHN)
12.4	Bearing type	Antifriction Ball / Roller
12.5	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.6	Hardness	Max hardness 200 BHN
13.0	SHEAVE	
13.1	Material	Fabricated from steel plate. IS: 2062 Gr. A or Gr. B / as per IS: 3938
13.2	Bearing type	Antifriction Ball / Roller.
14.0	BRAKE (HOIST and TROLLEY)	
14.1	Type	DC EM brakes disc type (fail to safety).
14.2	Capacity	150 % of FLT for hoisting, 125% of FLT for travel
14.3	Number	One number for each motor.
15.0	ROPE DRUM	As per IS 3938
15.1	Material	Seamless steel pipe. ASTM A106 / A53 grade B
15.3	Type of groove	Right hand groove or Right hand and left hand groove. (Shall be decided during detail engineering)
17.0	TYPE OF DSL (Travel)	PVC Shrouded bus bar (Cu) conductor type DSL
16.0	**Buffer stop/wheel stop**	Buffer shall be provide at the end of monorail beam
18.0	MOTORS	
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF.
18.2	Number of start	150 starts / hr.
18.3	Voltage, Phase and Frequency	415V + 10%, 3 phase, 4 wire, 50 Hz, ± 5 %
18.4	Class of insulation	Class “F” and temperature rise limited to class B.
18.5	Type of enclosure	TEFC
18.6	Degree of protection provided for enclosure	IP-55
18.7	Margin	Motor rating will be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified.

19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	2 nos. Snap action, self actuating type	One no. two way Lever type
20.0	Control panel	* Fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick. * Degree of protection shall be IP 54. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate shall be double brass compression type.	
20.1	Qty	1 No.	
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.	
22.0	**Emergency stop push button**	Provided. (Mushroom head)	
23.0	Cables	All cabling shall be XLPE insulated fire resistant (FRLS) cables	
24.0	Canopy	Canopy shall be provided for outdoor Electric Hoist	
25.0	Control Voltage	110 V (shall be derived through suitably rated 415/110V control transformer.)	

BHEL	**TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM TPS- FGD**	SPECIFICATION NO. PE-TS-439-563-A001
		VOLUME II - B
		SECTION -I
		REV 00 / DATE JULY 2020

ANNEXURES

BHEL	**TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM TPS- FGD**	SPECIFICATION NO. PE-TS-439-563-A001
		VOLUME II - B
		SECTION -I
		REV 00 / DATE JULY 2020

ANNEXURE-I

MAKES OF SUB VENDORS ITEMS

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE		
		FLEX-TRANS (formerly known as HICLIFF)		
		SAHARA		
		NUTECH		
		OEM		
4.	WIRE ROPE	USHA MARTIN		
		FORT WILLIAMS		
		BHARAT WIRE ROPES		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	SIEMENS		
		NGEF (up to 15KW)		
		CROMPTON		
		KIRLOSKAR		
		BHARAT BIJLI		
		MARATHON		
		ABB		
		LHP		
7.	BRAKES	ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
		PETHE		
8.	CONTACTOR	SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
		BCH		
9.	OVER LOAD RELAYS	SIEMENS		
		L&T		

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
16.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
17.	**PVC CONTROL CABLES**	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
18.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
19.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES	NOIDA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		COMPANY LTD		
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
20.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
21.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
22.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SCHNEIDER		
23.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
24.	PENDENT PUSH BUTTON STATION	OEM		
25.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
26.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
27.	PANELS	OEM		
		RITTAL		
		PYROTECH		
28.	RESISTANCE BOXES	ENAPROS		
		OEM		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
29.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
		CG POWER & INDUSTRIAL SOLUTIONS LTD		
30.	SHROUDED DSL	SUSHEEL		
		STROMAG		
31.	LOAD CELL	IPA		
		SARTORIUS		
32.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		BONGFILIOLI*		

Note:

1. **MAKE IS INDICATIVE, SUBJECT TO CUSTOMER'S / CONSULTANT APPROVAL DURING DETAIL ENGINEERING. ACCEPTANCE/NON ACCEPTANCE OF SAME SHALL NOT HAVE ANY IMPACT ON MANUFACTURING, DELIVERY SCHEDULE AND ON COST OF THE ELECTRIC HOIST.**
2. **THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.**

ANNEXURE –II

MANDATORY SPARES FOR ELECTRIC HOIST

Mandatory Spares For 10T Hoist

1.11	**Item**	**Quantity**
1.11.1	Bearings for travel wheels	2 sets
1.11.2	Bearings for gear boxes for each type of hoist	2 sets
1.11.3	Break liners for all the brakes	100% of total population of each type & size
1.11.4	Oil seals	100% of total population of each type, size rating
1.11.5	Brake springs for all brakes	-do-
1.11.6	Wire ropes for hooks	100% installed on each crane and hoist
1.11.7	Solenoid coils for brakes	2 sets
1.11.8	Overload relay for motors	2 Nos.
1.11.9	Limit switches for hoists and travel mechanisms	2 sets
1.11.10	Spare motors for hoists	2 Nos.
1.11.11	Travel machinery	
	i. Gear wheel	1 set
	ii. Internal clip	2 Nos.
	iii. Pinion	1 No.
2	Electrical Items	
2.1	415 Volt Motor (Upto 30 KW Rating)	
a	Driving End & Non-Driving End Bearing	2 Set for each type and rating of Motor
b	Cooling Fan	2 Nos. for each type and rating of Motor
c	Motor Terminal Block	5 Nos. for each type and rating of Motor
3	C&I Items	
b	Back-up panel mounted devices (Selector switches/ Push buttons/ Indicators etc.	5% of installed capacity
c	Lamps/ LEDs	100% of the total quantity
e	MCBs	10% of each type & rating
	Total Price	

Mandatory Spares For 3T Hoist

1.11	**Item**	**Quantity**
1.11.1	Bearings for travel wheels	2 sets
1.11.2	Bearings for gear boxes for each type of hoist	2 sets
1.11.3	Break liners for all the brakes	100% of total population of each type & size
1.11.4	Oil seals	100% of total population of each type, size rating

1.11.5	Brake springs for all brakes	-do-
1.11.6	Wire ropes for hooks	100% installed on each crane and hoist
1.11.7	Solenoid coils for brakes	2 sets
1.11.8	Overload relay for motors	2 Nos.
1.11.9	Limit switches for hoists and travel mechanisms	2 sets
1.11.10	Spare motors for hoists	2 Nos.
1.11.11	Travel machinery	
	i. Gear wheel	1 set
	ii. Internal clip	2 Nos.
	iii. Pinion	1 No.
2	Electrical Items	
2.1	415 Volt Motor (Upto 30 KW Rating)	
a	Driving End & Non-Driving End Bearing	2 Set for each type and rating of Motor
b	Cooling Fan	2 Nos. for each type and rating of Motor
c	Motor Terminal Block	5 Nos. for each type and rating of Motor
3	C&I Items	
b	Back-up panel mounted devices (Selector switches/ Push buttons/ Indicators etc.	5% of installed capacity
c	Lamps/ LEDs	100% of the total quantity
d	MCBs	10% of each type & rating

a. "One (1) set of each type & size" is defined as 100% requirement for one hoist.
b. 100% of total population of each type, size and rating is defined as 100% requirement for one hoist.

NOTES

1 Set for the particular equipment, would include all components required to replace the item, for example a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly. One (1) set means 100% requirement for one crane.

2 Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.

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

4 Any item which is quoted as "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

5 Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

6 Interchangeability and Packings:
All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre-set and/or preprogrammed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc. should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

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

8 Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification, same shall be deemed to have been covered in bidder's scope of supply.

ANNEXURE-III
PAINTING SPECIFICATION

A) Structural

Surface preparation : De greasing and Mechanical cleaning with wire brush or hand tool. (SA 1/ ST 2 / ST 3 as applicable)

Primer : Red oxide Zinc phosphate (Alkyd medium)- 2 coat , DFT 35 µ per coat.

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 2 coats, DFT 35 µ per coat.

Total DFT : 140µ

B) Electrical /Control Panel

Surface preparation: Seven tank process

Primer : Red Oxide Zinc phosphate (Alkyd medium)- 2 coat , Minimum DFT 35 µ per coat.

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 2 coats, Minimum DFT 35 µ per coat.

Total DFT : 140 µ

COLOR SHADE FOR CRANE

S. No	Item Description	Color Shade	Remarks
1	Structure	Golden yellow, shade 356 as per IS-5	
2	Bottom block assembly	Golden yellow, shade 356 as per IS-5	With black strip
3	Hooks	Golden yellow, shade 356 as per IS-5	With 100 mm wide black zebra strip
4	Panels and motors	Color shade for Control panels shall be Opaline green for exterior and semi glossy white for interior	

Notes:

1. Surface preparation shown above is as per Swedish Standards SIS 05-5900. Degreasing will be as per Standard SSPC-SP1.
2. In case of insulated surfaces, only primer coats shall be applied.
3. Gun metal/SS items with piping and G.I. pipes will not be painted. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish paint shall be applied at site. Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. Paint makes - Asian Paints/Berger Paints/Shalimar Paints/Goodlass Nerolac/Addison Paints/Grand Paints/Bombay Paints/Jenson & Nicholson/CDC Carboline/Jotun/Hemple/ Akzonoble

ANNEXURE IV- INSPECTION AND TESTING REQUIREMENT

Procedure for Load/Overload testing of Electric wire rope hoist at Manufacturer's Works

Objective: To demonstrate final No load, Load, Overload, Deflection & Functional tests of assembled hoist for the purpose of acceptance in line with IS 3938 and other relevant standards.

Basic Assumptions / Inputs for testing at Works:

1) Actual job hook shall be used for load, overload tests for hoisting.
2) Actual wire ropes shall be used for load, overload testing.
3) Shop cables can be used for temporary power supply for the purpose of showing various functional tests at shop.
4) Interlock and limit switch operation check will be shown for hoisting and CT motion.

Procedure for Load / Overload testing: Complete procedure shall be as per IS 3938.

1) All electrical and mechanical equipment shall be tested in accordance with the appropriate Indian Standards at the hoist or equipment maker's works.

2) The motor currents shall be checked and shall be within the rated full load current of each motor at safe working load. Normal speeds shall be achieved during full load tests.

3) The hoist shall be tested at manufacturer's works at 125 percent of the safe working load. The hoist shall be capable of lifting load from mid-air.

4) Brakes -The brakes shall be capable of holding a load 25 percent in excess of maximum safe working load when the load is suspended by the hook.

5) Safety device - Test for the effectiveness of the automatic device to limit the upward and downward travel of the hook.

6) Any test required by the purchaser beyond those called for in the appropriate Indian Standard shall be carried out.

7) Insulation Tests - Before the hoist is connected to the supply, the insulation of the electrical equipment shall be tested by a suitable instrument and any defect revealed shall be rectified.

8) All hoists performance test shall be duly certified by government approved agency.

ANNEXURE-V

A: DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

Sl. No.	BHEL DRG.NO	DRAWING TITLE	Primary/ Secondary	SUBMISSION SCHEDULE
1	PE-V1-439-563-A201	Manufacturing Quality Plan with Sub vendor list	Primary	R-0 WITHIN 21 DAYS FROM PO & SUBSEQUENT REVISIONS WITHIN 10 DAYS OF COMMNETS RECEIVED FROM BHEL. BHEL SHALL FURNISH COMMENTS/ APPROVAL ON EACH SUBMISSION WITHIN 18 DAYS FROM RECEIPT
2	PE-V1-439-563-A202	GA Drawing for Electric Hoist, DSL arrangement and painting details	Primary	
3	PE-V1-439-563-A210	Mechanism Sizing Calculation	Primary	
4	PE-V0-439-563-A219	Schematic Circuit Diagram including cable schedule and panel diagram	Primary	
5	PE-V1-439-563-A208	Erection procedure	Secondary	R-0 WITHIN 30 DAYS FROM PO & SUBSEQUENT REVISIONS WITHIN 10 DAYS OF COMMNETS RECEIVED FROM BHEL. BHEL SHALL FURNISH COMMENTS/ APPROVAL ON EACH SUBMISSION WITHIN 18 DAYS FROM RECEIPT
6	PE-V1-439-563-A207	Mandatory spare parts list	Secondary	
7	PE-V1-439-563-A218	Detailed BOM/BOQ for electric hoist	Secondary	
8	PE-V1-439-563-A206	O & M Manual	Secondary	Within 30 days of issuance of MDCC

Note: INCOMPLETE DRAWINGS/DOCUMENTS SHALL NOT BE TREATED AS SUBMITTED.

ANNEXURE -VI

Check List for Operation & Maintenance Manual

0Project name :
1Project number :
2Package Name :
3PO reference :
4Document number :
5Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**Cover page**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**Index**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**Description of Plant/System**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	**Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)**				
4.1	Pre-Commissioning Checks				

4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**Operation Guidelines for plant personal/user/operator**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**Maintenance guidelines for plant personal**				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning,				

	normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

Checked by
Dealing Engineer

Key Resource Person

Section Head

	TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM TPS- FGD	SPECIFICATION NO. PE-TS-439-563-A201	
		VOLUME - IIB	
		E IO - II	UB- E IO - II
		REV 00	DATE JULY 2020

SUB-SECTION - IIA
STANDARD TECHNICAL REQUIREMENT
(MECHANICAL)

TECHNICAL SPECIFICATION NO. PE-TS-439-563-A001

	TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM TPS- FGD	SPECIFICATION NO. PE-TS-439-563-A201	
		VOLUME - IIB	
		E IO - II	UB- E IO - II
		REV 00	DATE JULY 2020

STANDARD TECHNICAL SPECIFICATION

This specification covers the design, engineering, manufacture, inspection and testing at manufacturer's works, properly packed and delivery to site for the steel wire rope electric hoist as specified in the Data Sheet A enclosed. The equipment specified shall include all accessories required for trouble free operation.

2.0.0 Design Particulars

The steel wire rope electric hoist covered in this specification shall be suitable for the lift as specified in Annexure- A, Sec I, Vol IIB. Equipment offered shall be conforming to specification requirements as per IS: 3938 (latest edition) and other specified Indian Standards.

3.0.0 **Technical Particulars**

3.1.0 Type - Electrically operated with trolley.

3.2.0 Applicable IS

Applicable IS	DESCRIPTION
IS: 3938	Specification for electrical wire rope hoist
IS: 2266	Specification for steel wire ropes for general engineering purposes.
IS: 900	Code of practice for installation and maintenance of induction motor
IS: 4237	General requirement of switchgear and control gear for voltage motor exceeding 1000 Volts.
IS: 694	Copper conductors PVC insulated cables for voltage up to 1000 Volts
IS: 3043	Code of practice for Earthing.
IS: 1822	Motor starters for Voltages up to 650V.
IS: 2147	Degree of protection provided by enclosures for low voltage switch gear and control gear.
IS: 1554	PVC insulated (Heavy-duty) electric cables for working voltages and including 1100 volts.
IS: 325	Three phase induction motors.
IS: 15660	Point hook with shank.
IS 9968 Part I	Flexible trailing cables
IS: 4029	Guide testing induction motor.

4.0.0 Quality Plan & Inspection

To ensure that the equipment and services are in accordance with the specification, the vendor shall follow/adopt BHEL's STANDARD QUALITY PLAN (enclosed herewith)/Customer approved QAP to control

critical activities at all essential points. The enclosed standard quality plan should be duly signed and stamped as a token of acceptance and submitted by the bidder along with the offer.

Inspection shall be carried out by BHEL/customer representative as the case may be in line with the approved drawing / document.

5.0.0 Name Plate

All the electric hoists shall be provided with individual nameplate indicating minimum the following data's:

Name of manufacturer

Capacity (in tons)

Lift (in meters)

Serial No.

Any other detail as per IS 3938

6.0.0 Painting Procedure

6.1.0 Refer annexure-III, section-I for painting specification & color scheme

6.2.0 All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces.

6.3.0 Machined and bearing surface shall be protected with varnish or thick coat of grease.

7.0.0 GENERAL DESIGN FEATURE

I. Design shall conform to IS: 3938 (Latest edition) and other standards as specified.

II. Parts requiring replacement or lubrication shall be easily accessible & without dismounting type.

III. Equipment shall include the devices as required and comply with applicable standards/ specification requirements.

IV. Defects in material not acceptable/allowed. Rectification of any flaw is permissible only with the approval of Purchaser.

V. Hoist shall be rigid in construction and all movements shall be smooth and non-jerky.

VI. Design shall provide for easy maintenance of all parts, particularly the wheel bearings.

VII. Design shall conform to IS: 3938 and other standards as specified.

VIII. Both hoists and trolleys are driven electrically. Wheels shall be single flanged type and to suit different monorail beam sizes and the same shall be intimated to purchaser during of manufacturing stage.

IX. Hook shall be swiveling type and fitted with a safety latch.

X. Hoists shall be designed for minimum headroom above the highest position of hook and for closest hook approaches.

XI. Two no end stoppers of MOC IS 2062 and of adequate capacity shall be supplied for each electric

hoist.

XII. Gear Box: Gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. The gearboxes shall be of mild steel or cast steel as per IS 3938. All fabricated gearboxes shall be stress relieved. Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.

XIII. Bearing: Ball and roller antifriction bearing shall be used throughout, except where specified otherwise. Life of bearing shall be calculated in accordance with manufacturers recommendations. Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as possible to exclude dirt and prevent oil leakage.

XIV. Couplings: Motor shafts shall be connected to gear box input extension shafts through flexible gear coupling.

XV. Wire ropes: Ropes of steel /fibre core as specified in Data Sheet – A shall be of right hand lay, of 6x36 construction of best plough steel having minimum tensile strength as 160-180 kg/mm2. Left hand lay wire ropes shall not be used (Reverse bend ropes shall not be used).

8.0.0 ELECTRICAL MOTOR DESIGN

Motor shall be squirrel cage induction type, and suitable for AC supply of 415V, 3 /4 phase, 50 Hz, 40%/60% CDF (as per data sheet-A) with IP—55 degree of protection. Motors shall be class 'F' insulated with temperature rise limited class B & suitable for 150/300 starts per hour (as per data sheet-A). Motors shall conform to IS 325, IS 12615:2011 and IS/IEC 60034-1:2014 as per norms. Motor terminal box shall be provided with suitable earthing stud inside the terminal box. It shall be possible to rotate the terminal box by 90 degrees. Insulation shall be minimum Class F or better insulation materials with additional phase insulating material, extra end-turn bracing and Class H spike resistant wire. Motors shall be capable of a 20 second stall at six times full load current without injurious heating to motor components. The pull out torque of the motor shall not be less than 275 % of the full load torque. All the motors shall be suitable for reversing, frequent starting and braking.

9.0.0 Protective Panel / Controls

Heavy duty, electrical panel, direct on reversing type Air brake contactors, electrically interlocked for safety with necessary control gears such as control transformer, MCB (Control and Power), limit switches, thermostat, space heater, neutral link, ON/OFF 3 Phase door interlock switch, wrong connection preventor, overload relays, single phase preventor, indicating lamps, cable glands, lugs, terminals, cables etc. housed in totally enclosed IP- 55 degree of panel. Control voltage shall be 24V/110V.Actual control voltage level shall be informed on project to project basis. Control circuit shall be protected by individual control MCB's with minimum. short ckt. rating 9kA and rating 16A. The electrical protective panel shall be a cubicle fabricated from 2 mm thick sheet steel with lockable-hinged door. It shall be dust and vermin

proof with degree of protection as IP-55 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipments and devices mounted there on. The following minimum equipments shall be provided.

a) One triple pole air break type main contactor with thermal overload relay.

b) One triple pole main line connecting/disconnecting switch.

c) Switch fuse unit with D.O.L. starter for each motion.

d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.

e) Contactors, timer and auxiliary contactors.

f) Control transformer with fuses.

g) Indicating lamps to indicate the live condition of all three phases.

h) Other equipments as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The contactor drop off voltage shall be between 45-50% of rated voltage.

i) All internal wiring shall be identified with numbering ferrules at both ends as per the relevant wiring diagram.

10.0.0 LIMIT SWITCH

The hoist mechanism of the hoist shall be provided with rotary/gravity/snap action type limit switch to open the control circuit and in order to prevent the hook from over hoisting and over lowering. One gravity type back-up limit switch of hand-reset type shall be provided. This switch shall operate in the event of failure of main limit switch if called for in data sheet "A". Rotary + gravity type hand reset limit switches shall be provided for hoisting. Lever operated limit switches shall be provided for cross traverse. These limit switches shall be self-reset type.

The limit switches shall be housed in robust metallic oil and dust tight enclosure conforming to IP:65. At least 2 NO and 2 NC contacts shall be provided for each limit switch. All limit switch shall confirm to IEC-60947-5-1. Material of contact shall be high grade silver cadmium plated with high conductivity and non-corrosive type.

11.0.0 BRAKE

The hoist and cross traverse motors are fitted with an DC electro-magnetic disc type brake designed and built to arrest, and hold safely the full load capacity of load. The brakes shall be fail-safe type wherein failure of current immediately applies the brake.

12.0.0 PUSH BUTTON STATION

Pendent push button station shall be provided with glow type push buttons for hoisting/lowering, cross

traverse forward/reverse and emergency stop (mushroom head type) etc. The contactors are operated by pendent push button station suspended from the hoist for easy operation and suspension is made on steel wire/ link chain. Normally pendent shall be fixed type. Necessary, T track / taut wire arrangement including fixing arrangements such as auxiliary beam, brackets, supporting plates etc. as applicable shall be provided in order to clear the pendent and its cable from auxiliary structure, piping, equipment's etc. Necessary cable glands, lugs, terminals along with connecting cable of 14Core,1.5sqmm copper flexible cable shall be provided. Emergency stop push button shall be mushroom head (lockable) type. Push buttons shall return to off position when released. It shall be suspended by wire rope to prevent pull on the cables. The following minimum push buttons key operated type.

a) Main" ON", "OFF" push button key operated and lockable in "OFF" position. This push button will operate the main contactor.

b) Hoist and lower directions. (2Nos.)

c) Trolley travels both directions. (2 Nos.)

d) Inching speed for hoisting & lowering

e) Inching speed for trolley motion.

f) Creep speeds (if applicable)

h) Emergency stop push button (mushroom type).

i) Alarm bell push button.

13.0.0 EARTHING & GROUNDING

The hoist structure, motor frame and all other electrical equipments shall be grounded in accordance with the Indian Electricity Rules. The connections from hoist to 4th conductor of down shop leads shall be by means of current collector.

The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendent push button station shall be earthed separately and independently.

14.0.0 POWER SUPPLY TO HOIST:

Purchaser shall provide single point 415V, 3 /4 phase, and 50Hz supply at any point of the bay. Bidder shall provide main isolating switch at 1.5 M above the ground / operating floor level to receive this incoming power. The details of incoming cable shall be provided to the bidder on project to project basis during detail engineering. It shall be bidder's responsibility to supply isolators suitable for the incoming cable. Isolating switch shall be equipped with MCCB with three indicators for phases.

Power feeding to the hoist shall be thru one of the following methods-

i) Shrouded Bus Bar Conductor Type DSL complete with brackets and other fixing arrangements.

ii) EPR flexible trailing cable: Trailing cable shall be 1100 V grade, tinned copper, heat resistant, with EPR insulation and as per Class – 5 of IS-8130. Also should have inner PCP sheath and outer CSP sheath

with nylon chord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type complete with DSL trolley on T track / taut wire arrangement retractable type including necessary fixing arrangements such as auxiliary beam, brackets, supporting plates, junction box etc.

DSL/Flexible trailing cables shall be sized considering both hoisting, travel motion as well as other auxiliary power requirement. Voltage drop requirement of maximum 3% across the DSL/trailing cable from the incoming supply to motor terminal with hoist at extreme end of travel and with allowance of minimum 20% for wear & tear shall be considered while sizing the conductor along with other factors like derating etc . Calculation for the same be furnished as and when required by purchaser/end customer.

The collector system per conductor shall be spring loaded type metallic shoes to maintain adequate contact pressure.

15.0.0 WIRING SYSTEM:

a) The supplier shall furnish all power, control and auxiliary circuit wiring of the equipment and the panel located on the trolley.

b) The wiring shall be complete in all respect to ensure the proper functioning of the equipment.

c) Power wiring to any motor shall be done with 1100V grade Cu conductor, PVC insulated / armoured /FRLS cable of suitable sizes as specified in Data Sheet A.

d) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.

e) All control and auxiliary external circuit wiring shall be done with PVC insulated FRLS type 2.5mm stranded copper conductor.

f) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.

g) Each motor shall be wired independently. Power and control wiring shall be effectively separated.

h) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.

i) All wire termination to the panels shall be provided with clamp type connections screw. Type terminals with screw directly impinging on conductors are not acceptable.

j) Multi-way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring and outgoing.

k) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points

l) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

m) Adequate short circuit protection shall be provided for main and individual circuits.

n) All power & control cables shall be tagged at both ends (as per approved drawings) for quick identification. The cables & wiring system for each motion shall be independent & common runs shall be avoided. Power cables & control cables shall be effectively separated & all connections shall be terminated to terminal box suitable for outside connections.

BHEL	**TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDAM TPS- FGD**	SPECIFICATION NO. PE-TS-439-563-A001
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LIST OF DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid

a) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given in GCC. In case of no deviation, bidder to mention “No deviation” on signed and stamped copy of Deviation sheet.

b) Copy of pre-bid clarifications, if any, duly signed & stamped

c) Signed/ Stamped copy of Compliance cum Confirmation Certificate (Vol-III)

d) Un priced copy of price format indicating quoted/ not quoted against each row/column along with cost of withdrawal / price implication format for deviations.

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) 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 other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.

b) There are no other deviations w.r.t. specifications 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. This shall be within the contracted price with no extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out. 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 commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

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

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions.

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

PRE-BID CLARIFICATION SCHEDULE

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL