NEYVELI LIGNITE CORPORATION LIMITED
(NLC LTD)

NEYVELI NEW THERMAL POWER PROJECT
2x500 MW LIGNITE FIRED UNITS AT NEYVELI
(TURBINE GENERATOR PACKAGE)

PROJECT SPECIFIC
TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST

SPECIFICATION NO.: PE-TS-402-563-A002

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERIING MANAGEMENT
NOIDA
INDIA

	Title	Specification no.: PE-TS-402-563-A002
	TECHNICAL SPECIFICATION FOR WIRE ROPE ELECTRICAL HOIST 2X500 MW NNTPS (TG)	Rev. 00
		Date: DEC 2014
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		REV 00 / DATE DEC 2014

VOLUME - IIB

SECTION – A

SCOPE OF ENQUIRY

SCOPE OF ENQUIRY

1.1 The specification is intended to cover design, engineering, manufacturing, inspection and testing, painting, supply/ delivery duly packed at FOR site including erection & commissioning spares, maintenance tools & tackles, all accessories (isolating switch and power cable from isolating switch to DSL rails) including freight in line with drawings/ documents/ test procedures approved by BHEL/ Customer 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.

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 customer including their consultant as interpreted by BHEL in the relevant context.

VOLUME - IIB

SECTION – B

PROJECT INFORMATION
(PROJECT SPECIFIC)

SECTION - 2

2 GENERAL PROJECT INFORMATION

2.1 Introduction

The project site at Neyveli has distinct location advantages, being at pit-head distance from the source of lignite supply from Mines, making it convenient for transportation of lignite by belt conveyor. Water source is readily available from the nearby mines lake. Besides, other infrastructure such as access road, railway connection etc, already exist.

2.2 Power Plant Site

The power plant site is located at Neyveli, opposite to the now defunct Fertilizer and Briquetting & Carbonization Plant, near TPS-1 Expansion and TPS-II.

2.3 Project & Site Information

(i).	Owner/Purchaser	:	Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli, Cuddalore District, Tamil Nadu State, India
(ii).	Consultant	:	Lahmeyer International (India) Pvt. Ltd (LII), Gurgaon, NCR, India.
(iii).	Project Title	:	2x500 MW Neyveli New Thermal Power Station (NNTPS)
(iv).	Location	:	200 kms south of Chennai and 50 kms south-west of Cuddalore
(v).	Latitude	:	11° 34′ 00″ N to 11° 35′ 00″ N
(vi).	Longitude	:	79° 26′ 00″ E to 79° 27′ 00″ E
(vii).	Elevation above MSL	:	+67 m
(viii).	Nearest Railway Station	:	Neyveli,
(ix).	Nearest Sea Port	:	Chennai, at a distance of 200 km
(x).	Nearest Airport	:	Chennai, at a distance of 200 km
(xi).	Road Access/Approach to Site	:	Connected by Chennai-Thanjavur NH 45C road and state highway connecting Cuddalore – Virudhachalam via Neyveli. Both NH and state high way roads are well connected to NLC township roads.The approach road is approximately 15 kms from Chennai–Thanjavur NH – 45C road
(xii).	**Site Meteorological Data**		
	• Max ambient temperature	:	42.8° C

	• Min Ambient Temperature	:	26.9° C
	• Wet bulb temp	:	29° C
	• Max. Relative Humidity	:	92 % in the month of September
	• Min. Relative Humidity	:	23 % in the month of May
	• Rainfall	:	About 1265.7 mm annually (average)
	• Wind direction	:	South West to North East direction
	• Wind Speed	:	97.2 km/hr (maximum recorded) 4.3 km/hr (average wind speed)
	• Seismicity	:	As per IS: 1893 (part 4) (Zone-II) Importance factor: 1.75.
(xiii).	Languages spoken in the region	:	English, Tamil

* * * * *

VOLUME - IIB

SECTION – C

SCOPE OF WORK

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 Annexure A, Commissioning spares as per Annexure B. 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
2. Hoisting mechanism (motor and gear box, wire rope, load hook and hook block)
3. Electrical equipment (control panel, motor, limit switches)
4. Flexible trailing cable for motor, brake, limit switches, etc.
5. Painting of hoist.
6. Power supply thru' DSL including current collector, brackets etc.
7. O & M Manual, drawings and documents.
8. Testing of hoist.
9. Main isolating switch and power cable from 1.5M above ground / operating floor.
10. Any equipment / accessories not specified here but required to make the equipment complete and efficient shall be under bidder's scope of work.
11. Commissioning spares
12. Isolating switch

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. **Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity.** 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. 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: - The tools shall be supplied in one tool box .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.

The Bidder shall also supply erection & commissioning spares along with his main equipment as per Annexure A of Vol IIB, sec C. This shall form part of the main equipment supply.

Note:

Any Erection and Commissioning spares, if required over and above quoted items, the same shall be supplied by the vendor without any commercial implication to the purchaser

1.1.4 Mandatory Spares -

NA

1.2.0 **Services to be provided by the bidder**

1.2.1. Packing and forwarding and transportation to site.

1.2.2. Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by customer.

1.3.0. Inspection and Testing

As per enclosed BHEL standard quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be BHEL. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement at any stage of inspection deemed necessary by BHEL during detailed engineering shall be carried out without any commercial or technical implication.

1.4.0. **Drawing / design document for submission**

Drawing/design documents for submission and number of prints / copies required for various drawing and documents are listed in Annexure –V, section-C, volume II-B of this specification.

2.0.0. Works Excluded

2.1.0 Supply of ISMB monorail.

2.2.0 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 offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate “Schedule of Deviations” furnishing full particular of such deviations. 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 in the schedule of deviation attached with unpriced bid (also attached in Volume-III).

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**

The make of bought out items shall be considered as per Annexure-I, section C, Volume II-B of the specification.

6.0.0 **Packing**

In general packing shall be wooden box packing.

7.0.0 **Painting**

Refer attachment – "Painting Requirements" Annexure IV in Volume-IIB, Section-C.

8.0.0 **OTHER REQUIREMENTS**

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.

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.

	2X500 MW NNTPS (TG)		Rev 00			
	SCOPE OF ELECTRIC HOIST				Annexure A	
A	Electric wire rope hoist					
S. No.	**Equipment to be Handled/Area**	Capacity (T)	Height of lift (m)	Travel (m)	Qty (FOR 2 UNITS)	Type of path
1	DMCW pump/Motor (TG Aux.)	5	9	21	2	Straight
2	Vacuum Pump	3	8	21	2	Straight
3	CONTROL FLUID EQUIPMENT (HWR) HANDLING	3	8	10.5	6	Straight
4	CW BUTTERFLY VALVE HANDLING	12	12	10.5	2	Straight
5	MV Swgr room	5	9	5	1	Straight
6	TG elevator machine room	3	9	7	2	Curved
7	Service building elevator machine room	3	9	7	1	Straight
8	AC PLANT ROOM 1	5	8	30	2	Curved
List of Commissioning Spares – Annexure-B						
Sl.no	Description	Total quantity required	Unit			
A	for 3T capacity electric hoist.	7	Sets			
I)	Overload Relay					
ii)	Limit Switch					
iii)	Fuse Link					
B	for 5T capacity electric hoist.	3	Sets			
i)	Overload Relay					
ii)	Limit Switch					
iii)	Fuse Link					
C	for 12T capacity electric hoist.	1	Sets			
I)	Overload Relay					
ii)	Limit Switch					
iii)	Fuse Link					

ANNEXURE-I
MAKES OF SUB VENDORS ITEMS

S.N.	ITEM	MAKES
1.0	STEEL	SAIL/TISCO/ JINDAL
2.0	HOOKS	KARACHIWALA/ SMRITI FORGING / Steel Forging & Engg. Co., Kolkata
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN/ Bharat wire rope/FORT WILLIAMS
5.0	BEARINGS	SKF/ FAG/ TATA/ NBC
6.0	MOTORS	SIEMENS/NGEF/CROMPTON-Ahmednagar /KIRLOSKAR-Hubli, Bangalore / BHARAT BIJLI-Mumbai / ALSTHOM / ABB-Faridabad
7.0	BRAKES	ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE/PETHE/BCH
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ GEII/ L&T
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ TELEMECHANIQUE
14.0	TRANSFORMERS	INDCOIL / LOGICSTAT / PRAGATI / PRAYOG KAPPA / SOTHERN ELECTRIC / AUTOMATIC ELECTRIC / PRECISE ELECTRICALS / SILKAAN
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON (Except electric ballast)
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS / UML ENGINEERING
18.0	LIGHTING SWITCHES	ANCHOR / ELLORA
19.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT/POLYCAB/KEI
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT/POLYCAB/KEI
c)	FLEXIBLE TRAILING CABLES	NICCO / UNIVERSAL / POLYCAB / KEI
20.0	Cable gland	COMMET / SUNIL&CO. / ARUP ENGINEERING
21.0	PUSH BUTTONS	SIEMENS / L&T / BCH
22.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG
24	SAFETY SWITCHES	ALSTHOM / L&T / SIEMENS
25	PENDENT PUSH BUTTON STATION	OEM
26	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD
27	MCB	MDS / INDO COPP / STANDARD
28	PANELS	OEM
31	INSULATORS & COPPER CONDUCTORS	BHEL APPROVED MAKE
32	CASTINGS	KOLHAPUR STEEL / GNAT FOUNDRY / KIRTI ALLOYS
34	SHROUDED DSL	SUSHEEL / STROMAG

NOTE :- Bidder to note that the list of sub-vendor shall be adhered to, any addition/ deletion of sub-vendor by Customer during detail engineering will not call for any Commercial implication.

	MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT					
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE			WIRE ROPE ELECTRIC HOIST		
					REV	0	CONTRACT No					
					DATE	Dec-14	CONTRACTOR			BHEL		
					PAGE	1 of 4						

Sl.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
1.0	**RAW-MATERIALS**												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSEING, TROLLEY PLATE (AS APPLICABLE)	MECH. , CHEM. PROPS	MA	CHEMICAL COMPOSITION AND TENSILE STRENGTH	1 / lot	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	Mill.s TC	√	V	V	V	Test shall be carried out in absence of mill TC
1.2	GEARS, SHAFT/AXLES, WHEELS	MECH , CHEM. PROPS	MA	CHEMICAL COMPOSITION, HARDNESS (DURING IN-PROCESS)	I / LOT	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	In case the items are not manufactured in-house, the manufacturer's test certificate shall be submitted for chemical
		U.T FOR DIA/THK > 50mm	CR	NDT	100%	ASTM A 388	NOTE 4	INSPN. REPORT	√	P	**V**	V	
1.3	WIRE ROPE	Dimensional CHECK	MI	Dia.	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		BREAKING LOAD CAPACITY	CR	BREAKING LOAD	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS: 2266	APPROVED DRG/DATA SHEET AND / IS:3938 / IS:2266	MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	PHYS./ MECH. , CHEM. PROPS.	MA	CHEMICAL COMPOSITION, HARDNESS	I / LOT	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	W	V	**SHANK PORTION ONLY**
		PROOF LOAD CAPACITY	CR	PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	APPROVED DRG/DATA SHEET ≠ IS:3938 / IS:15560	INSPN. REPORT	√	P	W	V	
		DP AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
2.0	**IN-PROCESS**												
2.1*	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	SCRUTINY	100%	IS:7307 / ASME SEC IX	IS:7307 / ASME SEC IX	FORMAT OF IS / ASME SEC IX		P	V	V	
2.2*	PROCEDURE & WELDER QUALIFICATION	WEDLING PARAMETRES	MA	PHYS. TESTS/RT	100%	IS:7310 / ASME SEC IX	IS:7310 / ASME SEC IX	AS PER ASME SEC IX	√	P	W	W	IN CASE OF LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED

			LEGNDS			
			* RECORDS INDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION			
			** M: MANUFACTURER/SUBCONTRACTOR			
MANUFACTURER/ SUB CONTRACTOR		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"	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL	
SIGNATURE						

	MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT			2X500 MW NNTPS (TG)		
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE			WIRE ROPE ELECTRIC HOIST		
					REV	0	CONTRACT No					
					DATE	Dec-14	CONTRACTOR			BHEL		
					PAGE	1 of 4						

Sl.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
2.3*	WELD SET UPS	DIMENSIONS	MA	MEAS. , VISUAL	100%	WPS, APPD. DRG.	WPS, APPD. DRG.	INSPN. REPORT		P	V		
2.4*	WELDMENTS –FINAL RUN	SURFACE DEFECTS	MA	PT	100%	IS:3658 / ASTME:165	ASME SEC. VIII DIV. I	INSPN. REPORT	√	P	**V**	V	
2.5	**TRUNION / TROLLEY WHEELS**, GEARS PINION	SURFACE & INTERNAL FLAWS (**FOR DIA. / THICKNESS >50MM)**	MA	PT / **UT**	100%	ASTME:165	NO LINEAR DEFECTS / **NOTE-4**	INSPN. REPORT	√	P	W	V	
2.6	NDT OF LOAD BEARING BUTT WELDS (**IF ANY)**	WELD QUALITY OF a)Butt weld on tension 100% RT and 100% DPT b)Butt weld oncompression 10% RT and 100% DPT c)Butt weld on rope drum 100% RT and 100% DPT d) Fillet weld - Random 10% DPT	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	V	V	FILMS TO BE REVIEWED BY BHEL & Customer. DPT SHALL BE CHP FOR Customer & BHEL
2.7	**GEAR BOXES**												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS	MA	MEAS.	100%	MFG. DRG.	MFG. DRG.	INSPN. REPORT	√	P	V		
	Gear shall be checked for reduction ratio, backlash & contact pattern.	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE TEMP. RISE	MA	NO LOAD RUNNING FOR TWO HOURS	100%	MFG. DRG.	MFG. STD.	- DO -	√	P	V	V	
2.8	**ELECTRICALS**												
1	MOTORS	TYPE TESTS (INCLUDING DEGREE OF PROTECTION)	MA	TYPE TESTS	1 / TYPE, 100%	IS:3938	IS:3938	MFRS' TEST CERT., INSPN REPORT	√	P	V	V	
		ROUTINE TESTS		ROUTINE TESTS	100%	IS 325	IS 325	DO	√	P	V	V	
2	RESISTANCES (IF APPLICABLE)	TEMPERATURE RISE	MA	VERTIFICATION OF MNFRS' TEST CERT.	100%	IS:3938, RELV. ISS	IS:3938, RELV. ISS	MFRS' TEST CERT.	√	P	V	V	
3	CONTROLLER, LIMIT SWITCHES (IF APPLICABLE)	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:6975/TECH. SPEC.,	IS:6875/TECH. SPEC.,	MFRS' TEST CERT.	√	P	V	V	Rating and make to be verified.
4	BRAKES	ROUTINE TESTS	MA	ROUTINE TEST	100%	TECH. SPEC. / IS:15560	IS:3938/TECH. SPEC.	MFRS' TEST CERT.	√	P	V	V	
5	BRAKE DRUM (IF APPLICABLE)	VERIFICATION OF HT CHARTS, HARDNESS (IF APPLICABLE)	MA	VISUAL, HARDNESS TEST	100%	APPD. DRGS./TECH. SPC.	APPD. DRGS./TECH. SPEC.	HT. CHART /INSPN. REPORT	√	P	V	V	
6	CONTACTOR	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:2959 AND TECH. SPEC., IS:6547 / IS:3938	IS:2959 AND TECH. SPEC., IS:6547 / IS:3933	INSPN. REPORT	√	P	V	V	Rating and make to be verified.
7	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICHKNESS	MA	VISUAL	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	INSPN. REPORT	√	P	V	V	BOUGHT OUT ITEMS AS PER BHEL / CUSTOMER APPROVAL LIST

			LEGNDS			
			* RECORDS INDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION			
			** M: MANUFACTURER/SUBCONTRACTOR			
MANUFACTURER/ SUB CONTRACTOR		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"			
SIGNATURE				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL	

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT					2X500 MW NNTPS (TG)
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE					WIRE ROPE ELECTRIC HOIST
						REV	0	CONTRACT No					
						DATE	Dec-14	CONTRACTOR					BHEL
						PAGE	1 of 4						
Sl.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
8	CABLES	TYPE AND ROUTINE TESTS	MA	TYPE & ROUTINE TESTS	100%	AS PER TECH. SPEC. IS:1554/IS:9968- PART - I / IS:694 / RELEVANT IS FOR FRLS CABLES	AS PER TECH. SPEC. IS:1554/IS:9968-PART - I / IS:694	MNFRS' TEST CERT.	Ó	P	V	V	
3.0	FINAL INSPECTION												
3.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	
3.2	ASSEMBLED HOIST PERFORMANCE	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTRACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION	CR	MEAS & VISUAL	100%	IS:6547 / IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	
3.3	OVER LOAD TEST	1. OVER LOAD	CR	TEST AT 125 % OF-SWL	100%	IS:6547/IS:3938	IS:6547/IS:3938	INSPN. REPORT	√	P	W	V	
4	PAINTING												
1	PRIMER & FINISHING AND SHADE	1. TO RELEVANT IS	MI	CORRECTNESS OF MFG. TEST CERT.	EACH CONSIGN MENT	DRG. & DATA SHEET & RELV. IS SPEC.	DRG. & DATA SHEET & RELV. IS SPEC.	MNFRS' TEST CERT.		P	V		
	NOTE:												
	*** 1.0 Clause from 2.1 to 2.4 shall be applicable for load bearing welded joints.**												
	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.												
			LEGNDS										
			* RECORDS INDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION									
			** M: MANUFACTURER/SUBCONTRACTOR									
MANUFACTURER/ SUB CONTRACTOR		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"										
SIGNATURE							REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL					

ANNEXURE IV

PAINTING SCHEME

TABLE OF CONTENTS

17.1 General

17.1.1 This specification covers the materials, tools, facilities and quality requirement for surface preparation and painting of steel structures, mechanical & electrical equipments, technological structures, piping, ducts, chutes etc. for 2 X 500 MW Thermal Power Plant as elaborated in the further text.

This specification will be read in conjunction with other parts/ volumes of the Tender specification where other related project requirements have been indicated.

The term "Painting" referred herein covers rust preventive, preventive and decorative coating along with surface preparation of the following areas.

a) All Mechanical equipment, Technological structures, chutes, piping, ducts etc. unless otherwise specifically indicated in the relevant section

b) Various types of static and rotary equipment inclusive of electric motors etc. +

c) Steel tanks and vessels

d) Pipe work including trestles, supports, hangers, etc.

e) Metallic duct work such as ventilation ducts, gas ducts including supports, hangers, etc.

This is a general guideline to the paining scheme to be followed. However, in case if a specific painting procedure is stipulated in any tendering specification, then this general guideline will be superseded. Any special case which may arise from time to time will be dealt with individually on the merits of each case.

17.1.2 Surfaces made of aluminium, brass, bronze, stainless steel, and other corrosion resistant alloys are not required to be painted unless specified except for identification bands or for aesthetic purposes.

17.1.3 All machined mating surfaces (e.g. flanges) will be properly cleaned, and will be provided with protective coating before despatch.

17.1.4 The complete painting scheme for any item includes the following basic activities:

i) Proper surface preparation

ii) Application of primer coats

iii) Application of intermediate coats and

iv) Application of finish coats

All the above coats will be of quality paint products and of approved make as stipulated in this specification. The scope of work will also include supply of all paint materials as per specification described herein and of approved quality/ specifications.

17.2 Painting For Mechanical & Electrical And Other Equipment, Mechanical Structures, Piping, Ducts Etc.

17.2.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

17.2.2 Codes and Standards

Painting of equipment will be carried out as per the specifications indicated below and will conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5 :	Colours for ready mixed paints and enamels
IS:1303:	Glossary of terms relating to paints
IS:2379:	Colour code for identification of pipelines
IS:1477:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278 :	Code of practice for white washing and colour washing
IS:3140:	Code of practice for painting asbestos cement building products
IS:158 :	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting
IS : 2074:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS : 104:	Ready mixed paint, brushing, Zinc Chrome, priming
IS : 2932:	Enamel , synthetic, exterior (a) undercoating (b) finishing specification.

17.2.3 Preparation of Surfaces

a) Surface preparation being a pre requisite for any paint application, will be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint substrates.

b) All surfaces to be painted will 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 will be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents will be resorted to only in such areas where other methods specified above have not achieved the desired results.

Cleaning with solvents will be adopted only after written approval of the Purchaser/ consultant.

c) The workmanship will, in general, be in accordance with IS: 1477-1971. Surface of all the steel works to be painted will be thoroughly cleaned and degreased in accordance with IS:1477(Part-I) by means of mechanical and power tool cleaning or shot blasting. The cleaning quality will conform to second quality blast cleaning as per BS-4332 or to SA 2.5 of Swedish Standards Institution SIS 055900. Cleaning of surface will ensure primer coat is rigidly anchored to the virgin metal surface. Primer paint will be applied not later than 2-3 hours after preparation of surface, unless otherwise specified.

17.2.4 The acceptable surface preparation quality/grade are described under each painting scheme. The procedures covered are solvent cleaning, hand tool cleaning, power tool cleaning and blast cleaning

a) **Solvent** cleaning **(SP 1) (If applicable)**

The surface will be cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with an emulsion or alkaline solution to remove oil, grease, dirt, old paint, etc. Solvent cleaning will not remove rust, scales, mill scales or weld flux. Therefore, before application of paint, solvent cleaning will be followed by other cleaning procedures as stated below.

b) Hand tool cleaning (SP 2)

The surface will be cleaned by vigorous wire brushing done manually to St-2 quality. This method effectively removes loosely adherent materials, but would not affect residues of rust or mill scales that are intact and firmly adherent.

c) **Power tool cleaning (SP 3)**

The surface will be cleaned by electric or pneumatic tools to St-3 quality. The tools will be used carefully to prevent excessive roughing of surface and formation of ridges and burns. This method will remove loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent.

d) Blast cleaning (SP 4)

The surface will be cleaned by impingement of abrasive materials, such as graded sand at high velocity created by clean and dry compressed air blast. This method will remove loosely adherent materials as well as adherent scales and mill scales. Prior to application of blast, heavy deposit of oil and grease are removed by solvent cleaning and excessive surface scales are

removed by hand tools or power tool cleaning. The surface will be cleaned to Sa-2 1/2 quality which means that to 95% of surface area is free from all rust, mill scales and visible residues, foreign materials, etc. The blast cleaning is not recommended for sheet metal work.

17.2.5 Primer Paints (P)

After the surface is prepared in a manner acceptable to purchaser/ consultant, two (2) coats of Primer paints will be applied only on dry and clean surfaces. Second coat of red oxide primer will be applied only after first coat has dried up completely. Coating of primer will in general conform to IS:2074-92 and will be applied by brushing to ensure a continuous film without "holidays".

a) Primer paint P1: (Epoxy based)

A two pack air drying epoxy polyamide resin based red oxide –zinc phosphate (primer):

Epoxy content (% wt)	15 to 18
Air drying time	About 30 minutes (touch dry) Over night (hard dry)
Dry film thickness (DFT/coat)	30 microns (min)
Temperature resistance	Upto 120 deg.C dry heat

b) Primer paint P2 (Epoxy based)

A two pack air drying epoxy polyamide with zinc dust of at least 92% zinc dust on the dry film.

Epoxy content (% wt)	8 to 10
Air drying time	About 10 minutes (touch dry) 2 hours (hard dry)
Dry film thickness (DFT/coat)	40 microns (min)
Temperature resistance	Upto 300 deg.C dry heat

c) Primer paint P3 (Ethyl zinc silicate, EZS, based)

A two pack heavy duty zinc dust rich silicate primer:

Total solids (% wt)	84 ± 2
Air drying time	16 hours
Density	3.07 ± 0.005
Dry film thickness (DFT/coat)	60 microns (min)
Temperature resistance	Upto 450 deg.C dry heat

17.2.6 Intermediate paints (N)

These paints will be applied over primer coats as an intermediate layer to provide weatherproof seal of primer coats.

a) Intermediate paint N1

A two pack air drying high build epoxy resin based paint with MIO.

Air drying time	6 to 8 hours (touch dry) 7 days (full cure)
Dry film thickness (DFT/coat)	80 microns
Temperature resistance	Upto 180 deg.C dry heat
Compatible with	Primer P1

17.2.7 Finish Paint (F)

Finish paint coats will be applied over primer coats and intermediate coats after proper cleaning and touch up of primed coats. Synthetic enamel paint comprising of IS:2932-95 will be used for finish coats.

a) Finish paint (F1)

A two pack air drying epoxy polyamide enamel suitably pigmented.

Air drying time	2 to 3 hours (touch dry) 7 days (full cure)
Dry film thickness (DFT/coat)	30 microns
Temperature resistance	Upto 130 deg.C dry heat

Compatible with	Primers P1 and P2 Intermediate N1
Colour	Generally all shades

b) Finish paint (F2)

A single pack synthetic rubber based enamel paint.

Air drying time	2 hours (touch dry) 24 hours (hand dry)
Dry film thickness (DFT/coat)	25 microns
Temperature resistance	Upto 200 deg.C dry heat
Compatible with	No primers
Colour	Generally all shades

c) Finish Paint F3

A single pack heat resistant silicon Aluminum paint.

Air drying time	3 to 4 hours (touch dry) 24 hours (hard dry)
Dry film thickness (DFT/coat)	25 microns (min)
Temperature resistance	upto 400 deg.C dry heat
Compatible with	Primer paint P3
Colour	smooth aluminium

Heat resistant Silicone Aluminium Paint with suitable air drying time as per IS 13183 Gr I, 25 microns per coat.

d) After cleaning the dust on the dried up primer/ intermediate paint, first coat of synthetic enamel will be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint

will be applied only after gently removing the gloss of first coat from entire surface and it is dusted off the surface. The requirement of workmanship will be as per IS:1477-71.

e) Equipment No. and the name of the equipment will be painted on the surface of the equipment on visible locations in English. Service of the Pipe/Line designation with arrow identification for the direction of flow will be painted on all pipes at visible locations at an interval of 20 metres. Wherever pipelines are insulated, the service of the piping and arrow mark will be painted over the clad surface.

f) For painting of structure, equipment, tanks & vessels etc. suggested colour code is given in clause 17.2.8. For items not specified, the colour code to be followed for piping will be in line with IS 9404:2002 (Identification of pipelines used in Thermal Power Plants – Colour Code).

g) For insulated pipeline the finish paint will be applied at that place where colour band is to be painted on the aluminium sheeting. The finished paint (colour band) will be of 1m length at that place.

h) Colour band for piping will be applied at these following locations-

- At start and end point.
- At every 10m intervals.
- At every T joints and cross connection of piping.
- At every battery limit of pipeline
- Near valves before connection with the consumer.

i) Width of band

Size of pipe including insulated Pipe line outside diameter	Width of band
80 mm and below	25 mm
Above 80 mm upto 150 mm	50 mm
Above 200 mm upto 300 mm	75mm
Above 350 mm	100 mm

j) Direction of flow will be indicated by black or white arrow in contrast to the base colour on the pipeline. Length of the arrow will be minimum 125 mm and width will be minimum 65 mm. These will be put at an interval of 10 m.

17.2.8 Suggested Colour Codes For Painting of Structures, equipments, tanks & vessels etc.

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLUR (BAND	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark admiralty grey	632	-	-
2.	Fans, pumps, motors, compressors.	Light grey	631	-	-
3.	Outdoor ,Stand pipes, vent pipes	Aluminium	-	-	-
4.	Indoor Tanks	Aluminium	-	-	-
5.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
6.	Tanks (without insulation and cladding)	Aluminium			
7.	Switchgear	Light grey	631	-	-
8.	MCC/ PDB, Control, relay panels, Bus duct	Light grey	631/7078 of IS:1650	-	-

9.	Transformers	Dark admiralty grey	632	-	-
10.	Machinery guards	Signal red	537	-	-
11.	Turbine	Golden Yellow	356		
12.	Generator & exciter	Light grey	631		
13.	Piping (without insulation and cladding)				
14	Feed water	Sea green	217	Light brown	410
15	Condensate	Sea green	217	Light brown	410
16	D M Water	Sea Green	217	Light orange	557
17	Soft water	Sea green	217	French blue	166
18	Bearing cooling water	Sea green	217	French blue	166
19	Potable & filtered water	Sea green	217	French blue	166
20	Service & clarified water	Sea green	217	French blue	166
21	Condenser and Auxiliary Cooling water	Sea green	217	French blue	166
22	Service air	Sky Blue	101	-	-
23	Instrument air	blue	101	White	-
24	Lubricating oil	Light brown	410	Light grey	631
25	Control oil	Light brown	410	Light	557

				orange	
26	Transformer oil	Light brown	410	Light orange	557
27	Hydrogen	Canary yellow	309	Post office red	538
28	Carbon dioxide	Canary yellow	309	Light grey	631
29	Vacuum pipes	Sky blue	101	Black	-
30	Drainage	Black	-	-	-
31	Stand pipes and all Vent pipes	Aluminium	-	-	-

Notes:

Where band colour is specified, same will be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

17.2.9 Paint Application

a) Paint will be applied in accordance with manufacturer's recommendations. The work will generally follow IS 1477 (Part II) for jobs carried out in India and SSPC-PA-I or DIN 55928 or equivalent for jobs carried out outside India. Touch up paint to be applied to cover scratches after erection and assembly of equipment at site.

b) Paint will not be applied when the ambient temperature is 5 deg. C and below. Also paint will not be applied in rain, wind, fog or at relative humidity of 80% and above.

c) Each coat of paint will be continuous, free of pores and of even film thickness without thin spots. The first coat of finish paint at site will be applied preferably within three months of the shop paint.

d) Each coat of paint will be dry sufficiently before application of next coat.

e) Surface which cannot be painted but require protection will be given a coat of rust inhibitive grease according to IS:958-75 or solvent deposited compound according to IS:1153-75 or IS:1674-60.

f) Surface which will be inaccessible after assembly will receive minimum coats of specified primer. Surfaced to be in contact with wood, brick or other masonry will be given one shop coat of the specified primer.

g) Parts of steel structure to be embedded in concrete will be given a protective coat of Portland cement slurry immediately after fabrication and thoroughly cleaning the surfaces from grease, rust, mill scales etc. No paint will be applied on this part.

h) The Contractor will furnish paint manufacturer's test report or technical data sheet pertaining to the paint selected. The data sheet will indicate among other things the relevant standards, if any, composition in weight percent of pigments, vehicles, additives, drying time, viscosity, spreading rate, flash points, methods of application quality of surface preparation required, corrosion resistance properties and colour.

i) Rust preventive coating will be given to HSFG bolt and nut threads.

j) Machined surfaces / weld edges will be applied with a coating of temporary rust preventive oil.

k) All threaded and other surfaces of foundation bolts and its materials, insulation pins, anchor channels, sleeves will be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating will be removed using organic solvents.

l) The temporary rust preventive coating that already been applied on any components, tubes, pipes etc., will be removed by suitable solvents/ heating to 350-400 Deg.C for an hour before primer paint application-but, in case, it will be ensured that the minimum surface cleanliness required for primer paint application will be Sp2 (equivalent to hand tool cleaning).

m) All weld edge preparation for site welding will be applied with one coat of weldable primer.

n) For internal protection of pipes/tubes, VCI pellets will be used at both ends after sponge testing and ends capped. VCI pellets will not be used for SS components and composite assemblies.

o) Wherever inside surfaces of ducts need protection till erection, two coats of red oxide zinc phosphate primer (P1) paint to IS 12744 to a DFT of 60 microns will be applied after power tool cleaning.

17.2.10 Painting scheme

a) For a complete painting scheme of any item being painted, all types of paints are to be procured from the same manufacturer as approved by the purchaser.

b) The painting scheme to be followed for various mechanical/ electrical equipment / structures is briefly given below for guidance to the Contractor.

Legend

SP	Surface preparation quality
P	Primer Paint
2P1 stands for	Two (2) coats of primer paint type P1
N	Intermediate paint
1N 1	One (1) coat of intermediate paint type 1
F	Final Paint
2F1 stands for	Two (2) coats of finish paint type F1
DFT	Dry film thickness
CRT	Clean and retouch
Sa - 2.5	Quality of surface cleaning (i.e. 95 % of the surface area is free from all rust, mill scales and visible residues, foreign materials etc.

c) Painting Scheme

Sl no.	Description	Surface Preparation	Painting Scheme		Total DFT in micron
			At shop	At site	
1.	Steel Structure	Sa 2½	2P1 + 1N1	2F1	200
2.	Mechanical equipment (temp. not over 80 deg. C) Both static and rotary equipment	Sa 2½	2P1 + 1 N1	2F1	200
3.	Equipment with hot surfaces (temp. upto 400	Sa 2½	2P2	2F2	130

	deg. C)				
4.	Equipment with hot surfaces (temp. above 400 deg.C)	Sa 2½	2P3	2F3	170
5.	Non insulated pipe/ duct works - Temperature not over 80 °C - Temperature upto 200 °C - Temperature upto 400 °C	Sa 2½	2P1 + 1N1 2P2 2P3	2F1 2F2 2F3	200 50 170
6.	Insulated pipe/duct works	St3	2 coats of Alkyd Red Oxide Zinc Phosphate primer to IS 12744 – DFT 30μ/ coat	Not required	60
7.	Condensate piping, ACW, DMCW, service water, potable water and minor structures etc.	Hand tool/ Power tool cleaning to SSPC-SP2	2 coats of HB Chlorinated rubber based red oxide zinc phosphate primer each 50μ	2 coats of Chlorinated rubber based finish paint each	160

				30μ	

PAINTING SCHEME (METALLIC STRUCTURAL WORKS)				
SURFACES TO BE PAINTED	**SURFACE PREPARATION**	**PAINTING SCHEME**		
		PRIMER AT SHOP	**INTERM. AT SHOP**	**FINISHING AT SITE**
1) CARPENTRY ANCHOR PLATES AND PIPELINE SUPPORT				
- OUTSIDE	SA 2.5	2P1	1N1	2F1
- INSIDE	SA 2.5	2P1	1N1	2F1
2) BRIDGE CRANE				
- STRUCTURE FOR BEAMS	SA 2.5	P1 + P1(S)	1N1 (S)	2F1
- TROLLEY	SA 2.5	2P1	1N1	2F1
3) HOISTS AND MONORAILS				
- MONORAILS	SA 2.5	2P1	1N1	2F1
- HOISTS	SA 2.5	2P1	1N1	2F1

PAINTING SCHEME (THERMAL CYCLE)

SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERM. AT SHOP	FINISHING AT SITE
1) INSULATED PIPE LINE AND VALVES				
STEAM	SA 2.5	2P1/2P2/2P3	--	--
FEEDWATER	SA 2.5	2P1/2P2/2P3	--	--
DEAERATOR AND FEED TANK				
FEED TANK - INSIDE - OUTSIDE	SA 2.5 SA 2.5	Temporary rust preventive paint 2P3 or 2 coats of Heat resistant aluminium paint.		
DEAERATOR - OUTSIDE	SA 2.5	2P2 or 2 coats of Heat resistant aluminium paint.		
3) HEAT EXCHANGER				
- INSIDE	SA 2.5	--	--	--
- OUTSIDE	SA 2.5	2P1	1N1	--
4) HEATER				

PAINTING SCHEME (THERMAL CYCLE)				
SURFACES TO BE PAINTED	**SURFACE PREPARATION**	**PAINTING SCHEME**		
		PRIMER AT SHOP	**INTERM. AT SHOP**	**FINISHING AT SITE**
- INSIDE	SA 2.5	--	--	--
- OUTSIDE	SA 2.5	Heat resistant Aluminum paint	--	--
5) PUMPS	SA 2.5	2P1/2P2	1N1	2F1/2F2
6) VENT				
7) NON INSULATED PIPELINE AND VALVES	SA 2.5	2P1/2P2/ 2P3	--	2F1/2F2/2F3
8) DRAINS, PIPELINE AND VALVES TRAPS ETC				
- INSULATED	SA 2.5	2P1/2P2/ 2P3	--	--
- NON INSULATED	SA 2.5	2P1/2P2/ 2P3	--	2F2
8) TANKS				
- OUTSIDE	SA 2.5	2P1/2P2	--	--
- INSIDE	--	--	--	--

PAINTING SCHEME (OIL + GAS-OIL CYCLE)				
SURFACES TO BE PAINTED	**SURFACE PREPARATION**	**PAINTING SCHEME**		
		PRIMER AT SHOP	**INTERM. AT SHOP**	**FINISHING AT SITE**
1) CLEAN / DIRTY OIL TANK				
- INSIDE	SA 2.5	2P4	--	--
- OUTSIDE	SA 2.5	2P1	1N1	2F1
2) PIPE LINE AND VALVES				
- OUTSIDE	SA 2.5	2P1/2P2	1N1	2F1/2F2
- INSIDE	--	--	--	--
3) PUMPS				
- PUMPS	SA 2.5	2P1	1N1	2F1
4) FILTERS				
- OUTSIDE	SA 2.5	2P1/2P1	1N1	2F1/2F2
- INSIDE	--	--	--	--

PAINTING SCHEME (CIRCUALATING WATER AND SERVICE WATER)				
SURFACES TO BE PAINTED	**SURFACE PREPARATION**	**PAINTING SCHEME**		
		PRIMER AT SHOP	**INTERM. AT SHOP**	**FINISHING AT SITE**
1) CONDENSER - INSIDE - OUTSIDE	 SA 2.5 SA 2.5	 -- 2P1	 -- 1N1	 -- 2F1
- WATER BOX AND TUBE SHEET	SA 2.5	As per specification Volume IIA		
2) PUMPS	SA 2.5	2P1	1N1	2F1
3) PIPELINE AND VALVES - INSIDE - OUTSIDE (OVER GROUND)	 SA 2.5 SA 2.5	 -- 2P1	 -- 1N1	 -- 2F1

PAINTING SCHEME (DEMINERALISED WATER)

SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERM. AT SHOP	FINISHING AT SITE
1) PIPELINE AND VALVES - INSIDE - OUTSIDE	-- SA 2.5	-- 2P1	-- 1N1	-- 2F1
2) PUMPS - PUMPS	SA2.5	2P1	1N1	2F1

PAINTING SCHEME (AIR CYCLE)				
SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERM. AT SHOP	FINISHING AT SITE
1) PIPE LINE AND VALVES (SA) - OUTSIDE - INSIDE	SA 2.5 --	2P1 --	1N1 --	2F1 --
2) FILTERS / STRAINERS - OUTSIDE	SA 2.5	2P1	1N1	2F1

PAINTING SCHEME (AIR CYCLE)				
SURFACES TO BE PAINTED	**SURFACE PREPARATION**	**PAINTING SCHEME**		
		PRIMER AT SHOP	**INTERM. AT SHOP**	**FINISHING AT SITE**
- INSIDE	--	--	--	--

Note : For Piping, Supports, Hangers, CLH, VLH & Other piping system components/ items Painting Scheme as indicated in following table is also acceptable.

Sl. No.	**Description**	**Surface Preparation & Surface Profile**	Primer Coat		**Finish Coat**			
			Primer Coat	**No of coats & DFT**	**Paint**	**No of coats & DFT**	**Shade**	**Total DFT Microns (Min.)**
1	Insulated Piping, Components (MS/HRH/CRH/Aux Steam lines,.....)	SSPC-SP3/Power Tool cleaning	Red oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744	2 (30 microns per coat)	-----	-----	-----	60
2	Uninsulated Piping, components (Condensate, Boiler Filling, HP/LP dosing, Lube oil, Piping.....)	Hand Tool/Power Tool Cleaning to SSPC-SP2	HB Chlorinated Rubber based Red Oxide Zinc Phosphate Primer	2 (50 microns per coat)	Chlorinated Rubber based finish Paint	2 (30 microns per coat)	Smoke Grey Shade No 692 of IS 5	160
3	Structures	Hand Tool/Power Tool Cleaning to SSPC-SP2	HB Chlorinated Rubber based Red Oxide Zinc Phosphate	2 (50 microns per coat)	Chlorinated Rubber based finish Paint	2 (30 microns per coat	Smoke Grey Shade No 692 of IS 5	160

			Primer			)		
4	Hangers & Supports-(CLH,VLH)	Abrasive Blast cleaning to Sa 2 (35-50 microns)	Epoxy Zinc rich primer to IS 14589 Gr.II,% VS = 35 Min	1 (40 microns per coat)	Aliphatic Acrylic Polyurethane paint, % VS = 40 min	1 (30 microns per coat)	Phirozi Blue Shade No. 176 of IS 5	70
5	Pipe Clams	SSPC-SP3/Power Tool cleaning	Red oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744	1 (30 microns per coat)	Synthetic enamel paint long oil alkyd to IS 2932	1 (20 microns per coat)	Smoke Grey Shade No 692 of IS 5	70
6	Stainless steel/Galvanized items	No Paint	No Paint	No Paint	No Paint	No Paint	No Paint	No Paint

17.3 Painting Of Steel Structural Works

17.3.1 All structural steel works covered in the civil scope in Volume V will be painted as specified in Volume V (Design, Fabrication and erection of Structural steel works)

17.4 Submission Of Painting Schedule

Contractor will submit a comprehensive painting schedule indicating surface preparation quality, paint applied, total DFT, colour code etc. for Customer/ consultant's approval before the painting of any equipment/ component/ structure etc.

ANNEXURE-V

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	REMARKS	SUBMISSION SCHEDULE - WEEK NUMBER FROM DATE OF LOI
1	PE-V0-402-563-A100	Manufacturing Quality Plan with Sub vendor list	APPROVAL	2
2	PE-V0-402-563-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details	APPROVAL	3
3 PE-	V0-402-563-A102 S	chematic Circuit Diagram	APPROVAL	3
4	PE-V0-402-563-A103	Mechanism Sizing Calculation	APPROVAL	3
5 PE-	V0-402-563-A104 D	etailed BOM/BOQ for crane	INFORMATION	4
6	PE-V0-402-563-A105	O & M Manual	INFORMATION	6
7 PE-	V0-402-563-A107 E	rection procedure	INFORMATION	6

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order..

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

   a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

   b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

   c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

   d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

   e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

DOCUMENT MANAGEMENT SYSTEM

1.0 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 (http://124.124.36.198/wrenchwebaccess/login.aspx).**

DRAWING/DOCUMENT DISTRIBUTION LIST

All documents & drawings shall be in English and in metric units

SI		LII	NLC (HQ)	NLC-SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR	REMARKS
1	Master list of drawings / document (duly indicating schedule of submission)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
2	Drawings / document for Approval/Information (First Submission)	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy + 1 print		Soft copy	Soft copy (S)	
3	Return with comments/approval	Soft copy (S)	Soft copy	Soft copy		Soft copy	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
5	Drawings / documents for distribution (Approved by NLC, in cat. 1 or Received for Information)	Soft copy + 2 print (HQ+ Site)	Soft copy + 3 prints	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
6	Erection Drawings / documents	-	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
7	As built Drawings / documents	Soft copy + 1 print	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
8	Operation & Maintenance Manual	-	Soft copy + 1 print	Soft copy + 10 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
9	Type Test Certificate	Soft copy	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	

NOTES:

1. The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches. QAP documents to be submitted as per distribution schedule.
2. Date of submitting soft copy is to be taken as date of submission.
3. S – Source for generation of document.

NLC SPECIFICATION

11.1. ELECTRIC HOIST

11.12.1 SCOPE OF WORK

Scope of work of the Contractor will consist of design, manufacture, inspection, assembly, and painting at manufacturer's shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of Electric hoists of suitable capacity for maintenance of the equipment.

Contractor will select capacity, height of lift, quantity etc. as per system requirement considering that more than 2000 kg weight and / or more than 10.0 m lift of single heaviest item/ equipment to be maintained will be handled by Electric Hoists – else Manual Hoists may be provided.

11.12.2 TECHNICAL SPECIFICATION

a. The hoist will be designed in accordance with IS: 3938-1983.
b. For outdoor hoists, motors, brakes & other equipment will be covered to suit to outdoor operations.
c. All Electric hoists will be pendent operated.
d. Power supply will be through flexible trailing cables, which will be clamped with PVC or non-metallic clamps.
e. Power isolator will be provided at operating height.
f. Defects in the materials like fractures, cracks, blowholes, or laminations are not allowed.
g. No cast iron parts will be used except for electrical equipments and no wood or combustible material will be used unless specifically mentioned otherwise.
h. All working parts requiring replacements or inspection or lubrication will be easily accessible without the need for dismantling of other equipment or structure.
i. All bolts except those with nyloc nuts will be provided with grip lock nuts or spring washer.
j. All parts of the hoist will be thoroughly cleaned of all loose mill scales, rust or foreign matter & then painted as specified. All parts inaccessible after assembly will be painted before assembly & assembled while paint is still wet.
k. All Elec. hoists will be provided with maintenance / repair platforms of size 2X3 M with handrails and access/staircase at one end depending on the space availability.
l. All parts except motors, resistors, thrustors, solenoids, etc. will be de-rusted manually & painted before assembly& assembled while paint is still wet.

11.12.3 CONSTRUCTION FEATURES

Electrically operated hoist will be a complete unit with travelling trolley, hoisting motor, travel motor, rope drum, wire rope, necessary gearing, sheaves, brakes, hook, pendent push button station, contactor panel, all wiring, conductor for travel motion, limit switches, end stops, buffers, earthing terminals and other accessories to make the equipment complete in all respects. Electrically operated hoist will have minimum factor of safety as five (5).

Mechanical Details

Travelling Trolley

The travelling trolley will be motor driven. Trolley frames will be fabricated from rolled structural steel sections. The side plates of the trolley will extend beyond wheel flanges, thus providing bumper protection for the wheels. The two side plates will be connected by means of an equalising pin.

a. Wheel & drive

The electric hoist will run on two pairs of wheels, a pair of which will be driven by motor through reduction gear. The wheels will be of cast steel/forged steel, single flanged with taper / parallel treads to suit to monorail. The wheels will be machined on their treads to match the profile of the monorail. The wheels will be mounted on anti-friction bearings & will be easily removable for repair & replacement. The wheel diameter will be selected such that skidding does not take place even under unloaded condition.

b. Hoist mechanism

The hoist mechanism will consist of a bottom block fitted with a standard forged swivel hook of the specified capacity, supported on 2 or 4 falls of wire rope. However, non-spinning type of wire rope will be used for 2 falls rope arrangement. The wire rope will be wound on a grooved drum which will be sufficiently long to accommodate in one layer the length of rope requisite for the specified lift & in addition not fewer than two turns at each anchored end & one spare groove at the opposite end. The hoist drum will be motor driven through gears enclosed in oil filled reduction gearbox.

c. Rope Drum

Rope drum will be as per IS 3938. Rope drum will be either cast or welded to sustain concentrated loads resulting from rope pull. Drum will be machine grooved right and left with grooves of a proper shape for the rope used. Grooving will be of proper length to handle entire rope required to make the specified lift plus the two dead laps at each anchor point, without overlapping.

d. Wire Ropes

Wire ropes will be of Right Hand Ordinary (RHO) lay construction. The rope will be fastened to the drum with an attachment having strength equal to that of the rope. The rope fastening at theswinging end will be aligned so as toprevent rope coming off its reeling. Rope will be of sufficient length so that two (2) full laps will remain on the drum at extreme low position of the hook. Reverse bends or cross bends and bird caging will be avoided. The breaking loads for the hoist ropes will not be less than the factor specified in IS 3938. The load will include rated load on hooks, weight of the bottom block and the weight of rope. Wire rope for hoists will conform to IS:2266-2002

e. Gearing.

Straight & helical spur gearing will be used for all motions. Worm & bevel gears will not be used without specific permission from purchaser. Preferably all first reduction gears will have single helical teeth. All gears will be hardened & tempered alloy or carbon steel with machine out teeth. Surface hardening of teeth

is not acceptable. All gears will be enclosed in oil filled gear box except when not possible.

f. Couplings

Each motor will be connected to its gear drive by a flexible coupling.

g. Lubrication

All gears & bearings will be lubricated either by splash lubrication or by grease. If possible, all the lubricating points will be grouped together in easily accessible positions.

h. Bearings

Ball & roller antifriction bearings of reputed make will only be used, with minimum bearing life as per IS: 3938.

i. Brakes

D.C. Electromagnetic brake will be provided for each motion, however in case of conical rotor motors manufacturer's standard brake can be used. Contractor to indicate the type of break offered.

j. Shafts and Axles

Shafts and axles will be of forged steel and will have ample strength, rigidity and adequate bearing surface for intended duties. Shafts and axles will be accurately machined and properly supported. Shafts will, as far as possible, be furnished straight. If shouldered, these will be provided with fillets of ample radius or will be tapered to avoid loss of strength and stress concentration. These will be designed considering allowances for keys and splines.

k. Lifting Hook

The lifting hook will be single hook type, solid, forged, heat treated, of rugged construction and provided with a standard depress type safety latch. Lifting hook will have swivels and operate on ball or roller thrust bearings with hardened races. Lock to prevent hook from swivelling will be provided. Lifting hook will conform to IS 15560:2005 as applicable.

l. Buffers, Stops and Sweeps

Spring or rubber buffers will be provided on the trolley. Suitable end stops will be provided which will be welded on the ends of monorail to contact the buffers mounted on the trolley.

Trolley wheel stops will be provided before the end stops. These will match to wheel radius. Stops to prevent trolley from running off the monorail will be abutted against ends of monorail. Stops will be welded to the monorail.
Sweeps will be attached to the trolley to remove foreign material from the rails.

m. Guards

All exposed couplings, shafts, gear wheels, pinions, drives etc. will be safely encased and guarded.

The sheaves of hook blocks will be guarded to prevent trapping of hand between a sheave and the in-running rope

Electrical Details

Scope of supply

The electrical scope of work will commence from the power supply points in 415V Power distribution Board and will include but not be limited to the following : Contractor's scope of supply will include the following:

- Power cable junction box(fixed)
- Flexible festoon cable system with supporting rollers & guide rail for power cable and for control cable.
- Electrical panel housing main power disconnecting switch with fuses, main line contactor, control transformer with cut-outs on primary & secondary sides, individual mechanism motor control units & set of power & control terminals. If DC brakes & speed control system are employed, corresponding AC/DC converter & speed control devices are also to be included in the panel.
- Drive motors
- Brakes
- Limit switches
- Suitably rated control transformer 415/110 V
- Power & control cables for fixed wiring & hoist unit
- Pendant control station with suspension / Control posts as per Clearance Diagram
- Necessary erection & installation accessories required for wiring & set-up
- Power Isolator at operating height

Standards

The equipment will be selected as per the guide lines provided in the latest edition of the relevant Indian Standards. The equipment will also conform to the latest Indian Electricity Rules & other statutory Regulations prevalent at the place of installation as regards to safety requirements, earthing & other essential provisions specified therein.

Following will be followed:

Indian Standards, relevant international standards such as IEC, VDE, BS, JIS, NFPA etc.

Indian Factory Act 1948

Indian Electricity Act 1910

Indian Electricity rules- 1956, State's regulations.

Electricity regulatory commission Act 2002.

Ambient conditions

All electrical equipment including cables will be selected for an ambient temperature of 50 deg C and relative humidity of 88 %.

Power supply condition

Power supply to the hoist will be 415V +/- 10%, 3 phase, 50Hz +/- 5% AC 4 wire with solidly earthed neutral to be tapped from Station PDB/ACDB shown in SLD..

The following voltages will be used in the hoist:

415 volts,3 phase, 50 HZ - for motors 110 volts, single phase, 50 Hz -for electrical circuit of pendant control / control posts. 220 volts, DC for DC electromagnetic brakes.

The different voltages mentioned above, other than 415 V, 3 phases, 50 Hz will be obtained through individual separate transformers & transformer rectifier units connected to 415 V.

Each transformer will be provided with tappings at +5% & + 10% on the primary.

Electrical system will be designed for a fault level of 50 kA. Earthing system adopted will be type TN-CS.

Power supply collection & distribution

Incoming power supply to the hoist will be terminated at the line side terminal of sheet steel, dust proof cable junction box installed near hoist gantry in an accessible position. Contractor will provide proper flexible festoon cable system to deliver the power supply to the electrical control panel of the hoist. Electrical control panel of hoist will contain following equipment/devices:

a) A three pole isolator with suitably rated fuses to take care of the system fault. The rating of the isolator will be sufficient to carry the combined full load currents of the hoist & travel motor.

b) A three pole main line magnetic contactor suitable to carry the combined full load currents of hoist & travel motor.

c) Fuse & over load relays in the individual motor power circuit. The over load relays will be self reset type.

d) Reversing contactors for individual motor. The rating of the contactors will be atleast 50% higher than the respective motor full load current at the specified duty cycle. The minimum rating of the power contactor will be 30 amps. It will be heavy duty & of class AC-4 as per IS: 2959-1985.

e) Transformer & transformer rectifier set for control voltage supply & for supply to DC electromagnetic brakes respectively.

f) Speed control equipment as necessary. Plugging of motors will be avoided by suitable control.

Suitable arrangement will be provided to intimate control room during emergency in the form of audio-visual alarm. Necessary contacts/auxiliary relays will be provided.

The electrical panel will be sheet metal clad (16 gauge), totally enclosed (IP-54) with hinged & gasketed front door. Cable entry/exit will be through compression type cable glands.

Pendant control station

All drive motors will be controlled with individual magnetic reversing type cotactors operated through momentary contact push buttons (mounted on pendant unit/ control posts. The push button will return to the 'off' position as soon as the pressure is released. The release of the push button will immediately & automatically cause the brake to clamp. In addition to the start up 'ON' push button,

which energises the main contactor, one lockable 'OFF' push button will be provided in the push button station & will be connected in the main contactor coil circuit. The push buttons will be clearly marked as per the recommendations of IS: 3938-1983 to indicate the function of each button.

The pendant unit will be fixed either to the hoist unit or to the monorail as specified It will be capable of withstanding rough handling without damage. The weight of the pendant will be supported independent of cable by means of PVC sleeved chain or wire rope. The pendant will be effectively earthed. A chain or rope does not provide an effective earth connection & will not be relied upon for that purpose.

The reversing contactors for individual motors will be electrically interlocked. The control scheme adopted will ensure smooth normal speed lowering, hoisting & travel as specified.

The pendant will comprise of following push buttons and indicating lamps.

- Start & stop
- Trolley travel to & fro
- Hoist & lower
- Red lamp for supply ON

Limit switches

Hoist & travel motion will be provided with limit switches to limit the ultimate positions of the hook & the hoist block.

The limit switches will conform to the requirements specified in IS: 3938-1983/ International Standards.

Motors

All motors will be totally enclosed fan cooled, crane duty, squirrel cage induction motors. It will be ensured that these are special motors suitable for crane duty with pull out torque of not less than 150% of the rated torque. Motors will conform to IS:325-1996 . All motors will be suitable for 60 starts/hour.

The motors will be selected for the duty class of hoist unit. The duty cycle factor for each motor will not be less than 40%.

The motor selected will be suitable for frequent reversal, braking & acceleration. Motors will have class 'F' insulation with max. utilisation to within class 'B' admissible temperature rise corresponding to ambient air temperature as per clearance diagram. All windings will be impregnated for service in the tropics having ambient temperature as stated in the clearance diagram of the hoist.

Each motor will have a robust terminal box accurately fixed to the frame. Each terminal box will have ample room for termination of the aluminium conductor cables.

Brakes

Separate electromagnetic brakes, operated through direct current will be provided for each motor driven mechanism. Brakes will be of approved make & will be connected so as to apply automatically when power supply fails or when the push button is released or with adjustable delayed time lag preceded by electrical braking when the push button is released.

Brakes will be designed as per the latest edition of IS: 393 8-1983/ International Standards.

Disc brake may be provided for CT motion and shoe brakes may be provided for hoist motion.

Wiring

Fixed wiring on the hoist block will comply with following requirement:

- All cables will be installed with adequate protection against mechanical damage & damage from weather. Alternatively, multi-core armoured power & control cables, suitably clamped, may be used. Suitable clamping glands will be provided at both ends of each multi-core cable.
- All power & control cables will be tagged at both ends (as per approved drawings) for quick identification. The cables & wiring system for each motion will be independent & common runs will be avoided. Power cables & control cables will be effectively separated & all connections will be terminated to terminal box suitable for outside connections.
- Cable runs will avoid locations where high temperature and mechanical damage are likely to be experienced under service conditions.
- Adequate precautions will be taken to prevent ingress or collection of water or oil in any part of conduit or trunking system.

Enclosure class

The equipment in the hoist will be suitably protected against direct radiant heat and rain. It will be rendered proof against ingress of dust and vermin.

All electrical equipments like motors, junction boxes, electrical panel, limit switches, brakes etc. will be provided with enclosure class IP-54 for non-dusty or indoor environment and IP-55 for outdoor application.

Canopy will also be provided for outdoor hoist.

Cables

The cables for power connection on the hoist block unto electrical panel will comprise multi-strand PVC insulated and FRLS PVC sheathed, copper conductor, 1.1 kV grade cables. The conductor sizes will be selected after derating for the high ambient temperature, grouping & disposition of cables & keeping the voltage drop within the permissible limits & will have a minimum cross sectional area of 4 mm2 copper.

Conductor for control cables from electric hoist to electrical panel will be made of copper with standard construction & with a sectional area not less than 2.5 mm2. Festoon flexible cables for power & control applications will have EPR insulation & CSP sheathing. Flexible cables will be of finely stranded copper conductor having a min. Conductor section of 4 mm sq. copper for power circuits & 2.5 mm sq. for control circuits.

All cables will be adequately protected against mechanical damage, radiant heat & oil.

Power collection system

Power supply to the hoist unit will be through flexible festoon cable system. The festoon cable will be mounted on a retracting roller supports for the full length of the working zone parallel to the I beam carrying the hoist unit. The retracting trolleys will run on a separate supporting beam. Vendor s will specify the supporting beam

according to the retracting rollers offered by him to enable provide such beam in the building structure.

One end of the festoon cable will terminate in main cable junction box at the extreme end of the monorail beam. The other end will terminate on to the main power disconnecting switch located in the control panel. The flexible trailing cable will have ample length to cover full track length & will be supported at suitable intervals by means of properly selected movable trolleys. These retracting rollers will be prevented from bumping through suitable spacers so that undue stress is avoided on the cable. Similarly the trolleys will be inter-connected through metallic drag chains to avoid pull on cables. Suspension of flexible cable system below the support rail will be restricted to avoid mechanical damage & interference with operation.

Earthing

TN-CS type of earthing will be provided. This would require a separate earth conductor in the power cables, both for fixed wiring as well as for flexible festoon cables. Earth bus will be formed on the hoist and each equipment will be earthed through this earth bus.

11.12.4 PAINTING

The exposed surface of all items of equipment will be thoroughly cleaned and painted. Refer Chapter on painting section

11.12.5 INSPECTION AND TESTING

The manufacturer will conduct all tests required to ensure that the equipment furnished will conform to the requirements of the specification and in compliance with the requirements of the latest edition of IS: 3938-1983 or equal standards for electrically operated hoists.

11.12.6 PERFORMANCE & GUARANTEE

After erection and commissioning of equipment, performance tests will be carried out in accordance with IS: 3938-1983 and other relevant codes to prove the performance of the system and equipment.

These tests will be binding on the successful Contractor to determine compliance of the equipment /system with the performance guarantee.

All the equipment, tools and tackles required for successful completion of the performance tests will be supplied by the successful Contractor. All the instruments for the performance tests, as required, will be supplied by the successful Contractor and will be retained by him till the satisfactory conclusion of all tests at site. All costs associated with the supply, calibration, installation and return of test equipment will be included in the scope of supply. All test instruments will be as per standards approved by the Purchaser. If the successful Contractor fails to achieve the guarantee and performance parameters, he will investigate the causes and will rectify and/or replace, free of cost to the Purchaser the defects of the equipment/system within a period of 1 (one) month from the date of commencement of performance and guarantee tests and again prove the guarantees. In such cases, the cost of modifications including labour, materials, and cost of additional testing etc. will be borne by successful Contractor. If even after necessary alteration and modifications are affected, the performance guarantees are not fulfilled, the Purchaser reserves the right to reject the equipment.

In the event of exercising this right, the successful Contractor will replace the defective equipment/system with the equipment / system that meets the performance guarantee parameters. The cost of replacement inclusive of labour, materials and repeat testing to prove compliance with the performance guarantees will be borne by the Successful Contractor.

The following basic performance parameter tests will be concluded:

All equipment will operate at rated capacity without undue vibration and undue noise etc.

Continuous run system performance test.

All other parameters of the equipment or system indicated in the specification.

The hoists will be guaranteed for a period of 12 months from the date of successful commissioning or 18 months from the date of last supply whichever is earlier.

11.12.7 DOCUMENTATION

List of Drawing/ Documents to be furnished by the Successful Contractor for approval / reference

a) General arrangement drawing of equipment showing full details in plan and sections.
b) Quality assurance plan for inspection.
c) Specification of oils and lubricants and other consumables and their quantity and frequency of change (reference)
d) Detailed layout plan and sections for power supply system.
e) Exploded view of Hoist mechanism and trolley for maintenance purpose.

VOLUME- IV
SECTION-9,
MOTORS

TABLE OF CONTENTS

1 GENERAL

This specification is intended to cover the design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site and delivery of Electric Motor complete with all accessories for efficient and trouble-free operation of 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2 CODES & STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

IEC: 60034-1	:	Rotating electrical machines.
NEMA, MG-1	:	Motors and Generators
ISO : 1940-1	:	Mechanical vibration – Determination of permissible residual unbalance
IS : 325	:	Specification for three phase induction motor.
IS : 900	:	Code of Practice for installation and maintenance of induction motors
IS : 996	:	Single phase AC motors
IS : 1231	:	Dimensions of three-phase foot-mounted induction motors
IS : 1271	:	Thermal evaluation and classification of electrical insulation.
IS : 2223	:	Dimensions of flange mounted ac induction motors.

IS : 2254	:	Dimensions of vertical shaft motors for pumps
IS : 3043	:	Code of practice for earthing.
IS : 3177	:	Crane duty motors
IS : 4029	:	Guide for testing three phase induction motors.
IS : 4691	:	Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	:	Specification for rotating electrical machinery.
IS : 4728	:	Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	:	Methods of determination of efficiency of rotating electrical machines.
IS : 5571	:	Guide for selection of electrical equipment for hazardous areas.
IS : 6362	:	Designation of Method of Cooling of Rotating electrical machines.
IS : 8223	:	Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	:	Values of performance characteristics for

three phase induction motors.

IS : 12065	:	Noise level of motors.
IS : 12075	:	Measurement and evaluation of vibration of rotating electrical machines.
IS : 12615	:	Induction motors - Energy efficient, three-phase, squirrel cage - Specification
IS : 12802	:	Temperature rise measurement of rotating electrical machines
IS : 12824	:	Type of duty and classes of rating assigned.
IS : 14222	:	Requirements and method of Impulse withstand test
DIN/IEC/IS	:	RTD
BS 5308 part II	:	RTD triad Cable

Equipment 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 will be submitted along with the bid.

The electrical installation will 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 will be followed.

3 DESIGN CRITERIA

All motors will be suitable for an ambient temperature of 50 degree C and relative humidity of 85%. The motors will be suitable for operation in a highly polluted environment.

AC Motors will be of constant speed, squirrel cage, three/ single phase, induction type. Motors will be rated for continuous duty. They will also be suitable for long period of inactivity.

DC motors provided for emergency service will be shunt / compound wound type. Motor will be sized for operation with fixed resistance starter for maximum reliability.

Power supply for AC motors will be as follows:

- Below 0.22 kW : 240V, 1 Phase, 50Hz
- From 0.22 kW upto & including 160 kW : 415V, 3 Phase, 50Hz
- Above 160 kW upto & including 750 kW : 3.3kV, 3 Phase, 50Hz
- Above 750 kW : 11KV, 3 Phase, 50Hz

All AC motors will be suitable for following voltage & frequency variations as follows:

- Voltage Variation : (±) 10%
- Frequency Variation : (+) 3% to (-)5%
- Combined Variation of Voltage & Frequency : 10% (absolute sum)

The motor characteristics will 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.

Moreover, motors will be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

For 11kV motors, locked rotor current not to exceed 600% of full load including positive tolerance except BFP & CWP. (For BFP & CWP the starting current will be 450%of FLC). For 3.3 kV and 415 V motors Locked rotor current not to exceed 600% of full load with IS/IEC tolerance.

Maximum continuous motor ratings will be at least 15% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

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

The motors will be suitable for bus transfer schemes provided on the 11KV, 3.3kV and 415V systems without any injurious effect on its life. If motors are connected to an automatic bus transfer system, they may be subjected to 150% of the nominal voltage during changeover of buses due to the phase difference between the incoming voltage and motor residual voltage. In such cases, Motors will be capable of restarting under full load after momentary loss of voltage.

Motors will be of energy efficient of type Eff-2 as per IS: 12615/equivalent IEC/ International Standards.

Motor will be designed to keep torsional and rotational natural frequencies of Vibration of the motor and driven equipment atleast 25% above the motor operating speed range.

System Grounding

(a)	11 kV , 3.3 kV	:	Low Resistance Grounded to limit the earth fault current to 300 Amps
(b)	415 V	:	Solidly Grounded
(c)	220V DC	:	Ungrounded

Fault Level

(a)	11 kV , 3.3 kV	:	40 kA for 1 second
(b)	415 V	:	50 kA for 1 second
(c)	220V DC	:	15 kA for 1 second

Degree of Protection

(a)	Indoor Motors	:	IP 54
(b)	Outdoor Motors	:	IP 55
(c)	Cable Box located in Indoor Area	:	IP 54
(d)	Cable Box located in Outdoor Area	:	IP 55

Winding Insulation

(a)	For 11 kV/3.3 kV AC Motors	:	Class - F

(b)	For 415V AC Motors	:	Class - F
(c)	For 220V DC Motors	:	Class - F

Winding Conductor Material

(a)	For 11 kV/3.3 kV AC Motors	:	Copper
(b)	For 415V AC Motors	:	Copper
(c)	For 220V DC Motors	:	Copper

Bearing

(a)	For Drive End	:	Roller
(b)	For Non Drive End	:	Roller / Ball

Temperature Rise

(a)	For Air Cooled Motors	:	70 °C over ambient temperature
(b)	For Water Cooled Motors	:	80 °C over inlet cooling water temperature

Motor Earthing

(a)	Motors above 90 kW	:	50 x 6 mm GI Flat
(b)	Motors above 30 kW and upto 90 kW	:	25 x 6 mm GI Flat
(c)	Motors above 5 kW and upto 30 kW	:	25 x 3 mm GI Flat
(d)	Motors upto 5 kW	:	8 SWG GI Wire
(e)	Terminal Box	:	8 SWG GI Wire

Space Heater

(a)	For Motors and above 30 kW rating	:	Space heater suitable for 1Phase, 240V AC, 50 Hz supply
(b)	For Motors below 30 kW rating	:	No Space heater provided.

Painting

(a)	Paint Type	:	Epoxy based with approved class
(b)	Paint Thickness	:	Within 100 to 150 micron.

4 SPECIFIC REQUIREMENTS

4.1 Locked Rotor Withstand Time

HT Motor

- The locked rotor withstand time for HT motors under hot conditions at 110% rated voltage will be more than the starting time at minimum permissible voltage by at least three seconds or 15% of the accelerating time whichever is greater.
- Provision of speed switches will be avoided to the extent possible. In case speed switch is required to mount on the motor shaft, the same will remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch will be capable of withstanding 120% over speed in either direction of rotation.

LT Motor

- The starting time of the motor will be at the minimum permissible voltage.
- For motors with starting time upto 20 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit will be at least 2.5 second more than starting time.
- For motors with starting time more than 20 second and upto 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit will be at least 5 second more than starting time.
- For motors with starting time more than 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit will be more than starting time by at least 10% of the starting time.
- Speed switches mounted on the motor shaft will be provided in cases where above requirements are not met.

4.2 Starting Voltage Requirement

(a) 85% upto 1500 kW

(b) 80% for above 1500 kW upto 4000 kW

(c) 75% > 4000 kW

Motor will be designed for direct on line starting at full voltage. Starting current will not exceed 6 times full load current (subject to IS tolerance) for all auxiliaries.

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

H.T Motor will start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except for mill motors for which 90% RV will be the minimum starting voltage. L.T Motor will start with rated load and accelerate to full speed with 85% rated voltage at motor terminals.

Pump motor subject to reverse rotation will be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

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.

The motor will 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.

4.3 Winding and Insulation

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

(b) 11 kV and 3.3 kV AC motors : Winding material will be of copper. Insulation will be of Class F with winding temperature rise limited to Class B. They will withstand 1.2/50 microsecond switching surges of "4U+5 KV" (U=Line voltage in KV). The coil inter-turn insulation will be suitable for 0.3/3 micro second surge of 32 / 12 KV followed by 1 min power frequency high voltage

test of appropriate voltage on inter turn insulation.

(c) 415V AC & 220V DC motors : Winding material will be of copper. Insulation will be of Class F with temperature rise limited to Class B.

(d) Conveyor motors : Short circuit rings of conveyor motors will be either joint less or welded type. Brazed joint is not acceptable.

4.4 Motor Control

(a) For HT Motors

- Motors of rating above 160 kW and up to 750 KW will be suitable for 3.3 KV voltage
- Motors above 750 KW will be suitable for 11 KV voltage.
- Frequent starting motors of rating above 160 kW to 750 kW will be suitable to be controlled by vacuum contactors

(b) For LT Motors

- Motors of rating less than 90 kW will be operated by Contactor Electronic overload relays etc. from respective MCCs.
- Motors of rating up to 18.5 KW will be provided with MPCBs.
- Motors of rating above 18.5 KW and below 45 KW will be provided with MCCBs.
- Motors of rating 45 KW and above but less than 90 KW will be provided with MCCBs with CT operated Electronic over load relays .
- Motors of rating 90 KW and up to 160 KW will be suitable to be

controlled by Air circuit breakers from PCC, PMCCs, and will be provided with comprehensive numerical motor protection relays.

4.5 Starting duty

Motors will be suitable for 3 nos. consecutive Cold starts up and 2 nos. consecutive Hot starts up. Motors will be suitable for three equally spread starts per hour when the motor is under normal service condition. However in case of multiple start motors like conveyor motors three starts will be allowable from hot condition with maximum 20 starts per day and minimum 20,000 starts during life time of motor.

4.6 Bearings

- Anti-friction type radial and thrust bearings (ball, roller) and sleeve bearing will be rated for minimum standard life of 40,000 hours taking bearing and driven equipment loads (in case the drive is not having separate thrust bearing) into account. If bearings are lubricated, loss of grease will be scarce and it will not creep along shaft into motor housing. Facility of removal of excess grease will also be provided for grease lubricated bearings.
- Vertical shaft motors will be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if Anti-friction bearings can take vertical thrust, thrust & guide bearings are not required.
- Bearing will be effectively sealed against dust ingress and will be pressure grease gun lubricated. The bearing and housing will be so designed that greasing will be possible while the motor is running, without removal of covers.
- Where bearing supports are attached to the motor casing, adequate bracing will be provided on these supports to reduce vibrations and ensure life of bearings.
- If the bearings are oil lubricated, a drain plug will be provided for draining residual oil and oil level gauge will be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system will be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- Lubricants will be selected for prolonged storage and normal use of motors in tropical climate and will contain corrosion and oxidation inhibitors. Greases will have suitable bleeding characteristics to minimize setting. The selected lubricants will be indigenously available.
- Motors rated above 1000 kW will have insulated bearings to prevent flow of shaft currents.

4.7 Temperature Rise

- For Air Cooled Motors, temperature rise of insulation should be limited to 70 Deg C over ambient temperature by resistance method.

- For Water Cooled Motors, temperature rise of insulation should be limited to 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method.

4.8 Cooling

All motors will be either Totally Enclosed Fan Cooled (TEFC) or Totally Enclosed Tube Ventilated (TETV) or Closed Air Circuit Air Cooled (CACA) type. However, motors rated 3000 kW or above can be Closed Air Circuit Water Cooled (CACW).

4.9 Enclosure

- All motor enclosures will conform to the degree of protection of IP54 for indoor and IP-55 for oudoor installation unless other wise specified. Motor for outdoor or semi outdoor service will be of weather proof construction. Motors of large output rating located indoor could have screen protected drip proof (SPDP) enclosure conforming to IP-23.
- For motors located in outdoor & corrosive locations, FRP canopy will be provided. In case steel canopy is provided, the same will be epoxy painted to meet the surrounding atmosphere. Motors located in hazardous areas will have flame proof enclosures conforming to IS: 2148 as detailed below:

- Fuel oil area : Group – IIB

4.10 Noise Level and Vibration

- Noise level will be limited to 85 dB (A) at 1.5 meters from the motor. However the same will be as per IS: 12065 unless otherwise specified. The peak amplitude of vibration will be within the specified limits laid down in IS: 12075. Motors will withstand vibrations produced by driven equipment. HT motor bearing housings will have flats in both X and Y directions suitable for mounting 80mmX80mm vibration pads. Vibration pads with screwed holes for mounting vibration probes will be provided along with motors at both DE and NDE.

4.11 Temperature Monitoring

In HT motors, atleast four numbers simplex/ two numbers duplex platinum resistance type temperature detectors will be provided for each phase of stator winding. Each bearing will be provided with dial type thermometer with adjustable alarm contact and two numbers duplex Platinum resistance type temperature detector (3 wire 100ohm at zero deg C). In case of CACA and CACW motors dial type temperature indicator will be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). If alarm and trip

are required for cooling air temperature, temperature switch will be provided. The contact rating will be minimum 0.5A at 220V DC and 5A at 240V AC. Flow switches will be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing. The contact rating will be minimum 0.5A at 220V DC and 5A at 240V AC.

4.12 Earthing

Motor body will have two earthing points on opposite sides. Motor terminal boxes will also have separate grounding terminals.

4.13 Termination

- HT motors can be offered with either Elastimold termination or dust tight phase segregated double walled (metallic as well as with insulated barrier) cable boxes. In case Elastimold terminations are offered, then protective cover and trifurcating sleeves will also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) will be provided in case of cable boxes. The main cable box / terminal box will withstand a fault current upto 40 kA for 0.25 seconds for MV motors and 50 kA for 0.25 seconds for LV motors. Separate terminal boxes will be provided for space heaters and RTDs.
- Terminal box shall be capable of being turned through 360 degrees in step of 90 degrees. However in case of rectangular type, terminal box will be rotatable in steps of 180 degree.
- For HT motors the distance between gland plate and the terminal studs will not be less than 500 mm.
- Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed will be as follows:

Table 4.1

Minimum inter-phase & Phase earth air Clearances

S.No	Motor MCR in kW	Clearance, in mm
1	Up to 110kW	10
2	Above 110 and Up to 150kW	12.5
3	Above 150kW	19

4.14 Differential Protection

- For motors rated 11kV, 1000 KW & above, neutral current transformers of PS class will be provided on each phase in a separate neutral terminal box for differential protection.

4.15 Tropical Protection

- All motors will have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- All fittings and hardwares will be corrosion resistant.
- Space Heater
- Suitable single phase space heaters operated at 240V, 50Hz, 1Phase AC supply will be provided on motors rated for 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs will be provided.
- The space heater will be sized to maintain the motor internal temperature above dew point when the motor is in idle condition.
- For motor below 30KW, the motor winding will be suitable for continuous heating.

4.16 Rating Plate

Motor will have Stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / NEMA-MG-1 and following additional information:

a) Type of bearing and recommended lubricants along with location of insulated bearing.
b) Temperature rise under normal/abnormal conditions.
c) In addition to above, an arrow block will be screwed on to the body of motor on the non-driving end to indicate normal direction of rotation of motor.
d) Year of Manufacture

4.17 Drain Plug

Motor will 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.

4.18 Dowel Pins

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

4.19 Painting

The complete motor assembly including fan will be painted with corrosion proof paints of approved class.

4.20 Lifting provision

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

5 TESTS

5.1 HT Motors

5.1.1 Routine Test

All equipment will be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

5.1.2 Type Test

For each type & rating of HT motors the Contractor will submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor will conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

5.2 LT Motors

5.2.1 Routine Test

All equipment will be completely assembled, wired, adjusted and routine tested as per relevant IS/IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

5.2.2 Type Test

LT motors will be of type tested quality. For each type & rating of LT motors rated above 50 KW, the Contractor will submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor will conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

5.3 Test Witness

The tests will be carried out in presence of the Owner's representative, for which a minimum 7 days notice will be given by the Contractor. The Contractor will obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure will clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

5.4 Test Certificates

- Certified copies of all tests carried out at works and at site will be furnished in requisite no. of copies for approval of the Owner.

- The equipment will be dispatched from works only after receipt of Owner's written approval of shop test reports.

6 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors will be submitted as indicated below:

Dimensional General Arrangement drawing

- Motor sizing calculation
- Foundation Plan & Loading
- Cable end box details
- Space requirement for rotor removal
- Thermal withstand curves hot & cold
- Starting and speed torque characteristics at 80% & 100% voltage
- Complete motor data
- Erection & Maintenance Manual
- Test reports
- QAP

VOLUME- IV

SECTION-16

LV POWER & CONTROL CABLE

TABLE OF CONTENTS

1 GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport to site of LT Power & Control Cable complete with all accessories for efficient and trouble-free operationfor 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2 CODES AND STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below or any international standard acceptable to purchaser.

IS:1554(Part I)	:	PVC insulated(heavy duty) electric cables for working voltage up to and including 1100V
IS:1554(Part II)	:	PVC insulated(heavy duty) electric cables for working voltage from 3.3kv up to and including 11Kv
IS: 3961	:	Recommended current ratings for cables.
IS: 8130	:	Conductors for insulated electric cables and flexible cords
IS:5831	:	PVC insulation and sheath of electric cables
IS: 2982	:	Copper conductor in insulated cables and cords.
IS: 3975	:	Mild steel wires, strips and tapes for armouring cables
IS: 5609	:	Specification for low frequency wirers and cables with PVC insulation and PVC sheath
IS: 6380	:	Specification of elastomeric insulation of sheath of electric cables.
IS: 434(I and II)	:	Specification for rubber insulation cables.

IEC: 540	:	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC: 230	:	Impulse tests on cables and their accessories
IEC: 60	:	High voltage test techniques
IEC: 287	:	Calculation of the continuous current rating of the cables(100% load factor).
IEC: 288	:	Nominal cross sectional area and composition of conductor of insulated cables.
IEC: 502	:	Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
NEMA-WC-5	:	Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
IEEE: 383	:	Standard for type test for class IE electric cables, filled splices and connection for nuclear power generation station.
IEC: 332-1	:	Test on electric cables under fire conditions.
ASTM-D-2843	:	Standard test method for density of smoke from burning/decomposition of plastics.
ASTM-D-2863	:	Test for determination of oxygen index.
IEC-754-I	:	Test method for acid gas generation
IEC-331	:	Fire resisting characteristics of electric cables

SVENSK Standard SS-4241475 Class F3

- BICC Hand Book For cables in fire regarding temperature index-chapter-6
- Indian Electricity Rule.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted will have to be submitted along with the bid.

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

3 DESIGN CRITERIA

The cable will be used for connection of power and control circuits of the auxiliary electrical systems.

The cable will be suitable for installation in the required site conditions.

Cables will be sized suitably with proper derating factors as per the installation conditions of the cable.

For continuous operation at specified rating as well as during short circuit condition the maximum conductor temperature will be limited to the permissible value as per relevant standard.

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

Armouring, wherever provided, will be single round/ flat wire of galvanised steel for multi-core cables and aluminium for single core cable. Cables in buried formation will be armored. Cables laid in duct banks/conduits will be unarmoured.

The outer sheath as well as the inner sheath will have flame retardant low smoke (FRLS) characteristics and will meet the requirements of additional tests specified for this purpose.

Core identification for multi-core cable will be provided by colour coding.

Power cables will be chosen taking into account the following factors:

a) System Fault level.
b) Maximum time for fault clearance (i.e, operating time of the back up protection relays plus the time of operation of the circuit breakers).
c) Full load current of the circuit.
d) Short circuit current and duration 0.2 sec (for breaker protected cables)
e) Installation conditions.
f) Voltage drop under normal running and starting condition
g) Voltage drop at motor terminals will be within permissible limit during starting & normal running.

h) The cable should withstand the maximum fault current corresponding to the particular voltage level for the minimum time before the fault is cleared.

i) Consideration will also be given to limit the cable to the nearest standard sizes instead of using too many types.

j) The standard cable sizes, ampacities, derating factors, etc. will be as given in IS or relevant standard.

k) The minimum size of power cables to be used will be as follow :

Aluminium conductor	:	6 Sq. mm.
Copper conductor	:	2.5 Sq. mm.

4 SPECIFIC REQUIREMENTS

4.1 Type of Cable

LV power cables will be stranded aluminium conductor, cross linked polyethylene (XLPE) insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC sheathed cables conforming to IS : 7098.

Control Cables will be 1100 V grade with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed cables conforming to IS : 1554.

4.2 Conductor

The cable conductor will be made from standard Aluminum for LT Power cables and Copper for control cables to form compact conductor having a resistance within the limits specified. All the cables of size 25mm^2 and above will have sector shaped conductors.

4.3 Insulation

The insulation of the LV power cable will be XLPE type & for control the insulation will be PVC type. It will be designed and manufactured for the specified system voltage. The manufacturing process will ensure that insulation will be free from voids. The insulation will withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give a very smooth interface between semi conducting screen and insulation. The insulation of the cables will be of high standard quality.

4.4 Inner Sheath

The sheath will be suitable to withstand the site conditions and the desired temperature. It will be of adequate thickness and applied by a continuous process to produce a sheath of consistent quality free from all defects. PVC sheath will be extruded.

4.5 Armour

Hard drawn aluminum wire armouring/ galvanized steel tape/ wire armouring will be used for single core and multi-core cable respectively. Cables should be un-armoured wherever indicated. The hard drawn aluminium wire for armour will be of H4 grade, as per IS-8130 (having tensile strength above 150 N/mm2). The

diameter of the aluminium wire will be as per the table for the dimensions of the galvanized steel wire armour given in the relevant standard.

4.6 Outer sheath

FRLS extruded black PVC serving as per IS: 1554 otherwise will be applied over the armouring with suitable additives to prevent attach by rodent and termites. All serving must be given anti-termite treatment.

4.7 Packing

- Cables will be supplied in non-returnable drums. Drum lengths will be such so that cable joints are totally avoided. The drums will be of heavy construction. All wooden parts will be manufactured from seasoned wood. All ferrous parts used will be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum will be treated by immersing in copper-nitrate solution.
- The ends of each cable length will be sealed before shipment. Heat shrinkable cable cap will be used for this purpose.
- A label will be securely attached to each end of the reel indicating the Purchaser's order number, Owner's identification mark i.e. "NNTPS ", length, type, voltage grade, conductor size and number of cores of the cable. A tag containing the same information will be attached to the leadings end of the cable inside. An arrow and necessary instructions will be marked on the drum indicating the direction in which it should be rolled. Drum numbers are to be indicated on the cable drums.

4.8 Spare Core

Multi-core control cables will have 20% spare core, minimum one spare.

Separate cables for each type of following services / functions as applicable will be used for each feeder. Same multi-core cable using different services will 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.

4.9 Constructional Requirements

a) Cable will have suitable filters laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers will be suitable for the operating temperature of the cable and compatible with the insulating material. All materials will be new, unused and of finest quality.
b) Workmanship will be neat, clean and of the highest grade.
c) LT Power cables will be 1.1kV grade, heavy duty, stranded aluminium conductor, XLPE Insulated galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type outer sheathed.

d) Control cables will be 1.1kV grade, heavy duty, stranded copper conductor, PVC Type-A insulated, galvanized steel wire armoured, flame retardent low smoke (FRLS) extruded PVC of Type - ST1 outer sheathed.

e) Special Properties:
All the above cables will be conforming to the relevant Indian/IEC standard in general, with the following special properties:

- Oxygen Index of the outer sheath will not be less than 29, when tested as per ASTM-D-2863.
- Temperature Index of the outer sheath will not be less than 250 °C, when tested as per ASTM-D-2863.
- Halogen acid contents in outer sheath will not be more than 20%, when tested as per IEC-60754.
- The maximum smoke density in percent light absorption should not exceed 60% in case of PVC compound and 20% in case of fire survival cables, when tested as per ASTM-D-2843.
- Swedish chimney test as per SS-4241475 class F3 and ladder test for flammability as per IEEE-383.

4.10 Joints and Terminations

Materials of construction for a joint/termination will perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts will incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations will 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. No joints will be allowed unless the cable drawn length is exceeded.

4.11 Cable Identification

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

a) Manufacturer's name or trade mark
b) Voltage grade
c) Year of manufacture
d) Type of insulation.
e) Type of outer sheath e.g. "FRLS" etc.
f) ISI marks
g) Nominal cross sectional area of the conductor & no of cores
h) Sequential marking
i) Owner's identification mark "NNTPS"

5 TESTS

5.1 Type Test

Cables will be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the date of bid opening will be submitted.

These reports will be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available the same will be conducted in the presence of the purchaser.

5.2 Shop Tests

The Cables will be tested in accordance with relevant IS/IEC standards at manufacturers' works in the presence of consultant /purchaser or his representative as given below:

- Routine tests on each drum of cables.
- Acceptance tests on drums chosen at random for acceptance of the lot will be conducted in the presence of Consultant / purchaser or his representative.

5.3 Additional Tests

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

a) Oxygen index test (for both C1 & C2) – The oxygen index test will be carried out as per ASTM D2863. The Oxygen index will not be less than 29. All the additional tests will be conducted in the presence of the purchaser.

b) Temperature Index Test (for both C1 & C2) - The measured value of temperature index will be 21 at a temperature of 250°C.

c) Flame retardance test on single cable and on bunched cables (for 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.

d) Halogen acid gas evolution test (for category C2) – This test will be as per IEC-754-1.The level of HCL evolved will not exceed 20 per cent by weight.

e) Smoke density test (for category C2) – Smoke generation by outer sheath under fire as per ASTM D 2843. The cables will meet the requirements of light transmission of minimum 40% after the test.

f) Test for rodent & termite repulsion property.

6 FIRE PROOF SEALING SYSTEM

Fire proof sealing system will consist of Fire-stops/fire-seals for sealing of cable/cable tray and conduit/pipe penetrations, both horizontal and vertical, through brick or RCC walls/floors, to prevent the spread of fire from one area, which is separated from others by fire-resistant barriers.

'Fire-breaks' provided on long runs of cable racks/trays to prevent the propagation of fire along the cable rack, within a single fire-area or fire- zone.

The FPS system will also include all the necessary accessories and equipment required for supporting, holding in position, fixing and installation of the fire-stop/fire-break.

The FPS system will comply in all respects with the requirements of the codes and standards listed below

IEEE-634 ASTM-E-814

ANSI-IEEE-383 IEC-331 IEC-332

Fire stop/ seal

The FPS system adopted for cables or cable trays penetrating through walls and floor constitute a openings, or cables passing through embedded conduits / pipes / pipe- sleeves, fire stop / seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Fire Break

The fire proofing system, other than fire-stops, adopted to retard flame propagation long runs of horizontal or vertical cable trays in the same fire zone or area, in an event of a fire, will constitute a `fire-break' and will be provided by applying a suitable fire –resistance coating on cables and cable trays for the required length, with or without a fire resistant panel, at the point of the fire break to obtain the fire-rating specified.

Application of fire proof sealing system

Fire stops will be provided for cable penetration openings listed below

The passage of cables/cable trays pipe sleeves/embedded conduits through walls / floors.

Vertical raceways, which carry cables between successive floors, through openings provided in the RCC floor slab, will be sealed by fire stops at each floor level.

Cable entry through openings in floor slabs below HT/LT switchgear, MCCs, various Control and relay panels and other bottom entry panels, will be effectively sealed by fire stop

Location of fire breaks

Firebreaks will be provided on both cable rack and trenches at all cable tray Intersections and tee-offs.

On linear runs of cable trays between fire stops or fire breaks, fire breaks will be provided at intervals of 15 metres on horizontal cable runs and 5 m on vertical cable runs.

Fire breaks in linear runs of cable trenches between intersections and tee-offs will be provided at intervals of 30 metres.

Contractor will furnish the test certificates for the fire stops and fire breaks after award of contract for Owner/Owner's Representative review. If the certificates are not satisfactory all the tests will be conducted free of cost. The offered system i.e. fire stops and fire breaks will be identical (or better) with the system which is successfully type tested for the specified rating i.e. the composition density of the material, thickness of coating in case of fire breaks and any other properties of the material / system offered will be identical or better than the tested system and will be subject to Owner / Owner's Representative.

Test on fire stops

The fire stops will be subjected to the following type tests:

Fire Rating Test

Hose Stream Test

Type tests will be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens, will be similar to the largest of the sizes being used in the plant.

Preconditioning of fire stop test specimens before conducting the fire rating and hose stream tests, each test specimen will be preconditioned for thermal ageing, water immersion and vibration.

Test on Fire Stops

During the fire rating test, the transmission of heat through the cable penetration fire stop will not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 200oC.

Tests on fire breaks

Firebreaks will undergo the following tests as per ANSI-IEEE-383:

Ampacity test

Flame test

7 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

- Cable datasheets
- Cable sizing
- QAPs & Test Reports
- Relevant catalogues

8 RATINGS AND REQUIREMENTS

8.1 L.V. Power cables 1100 V grade

1100 V grade, power cable conforming to following requirement and in line with IS-1554, IS-5831, IS-8130 & IS-3975.

Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2/stranded, high conductivity annealed plain copper as per Annexure, generally conforming to IS:8130
Insulation	:	Extruded cross linked polyethylene (XLPE).
Inner Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS:5831 for multicore cable.
Armour	:	Galvanised single round/ strip steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
Overall Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS:5831.

8.2 Control Cables 1100 V Grade

1100 V grade, 700 C rating, PVC Control cable conforming to following requirement and in line with IS-1554, IS-8130, IS-5831 & IS-3975.

Conductor	:	Stranded, non-compacted & circular, high conductivity annealed plain copper,

generally conforming to IS:8130.

Insulation	:	Extruded PVC compound conforming to type A of IS:5831.
Inner sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831 for multicore cables. Single core cables will have no inner sheath
Armour	:	Galvanised single round steel wire for twin and multicore cables.
Overall sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831

8.3 Trailing Cables (Power & Control)

Trailing cable, 1.1kV grade with highly flexible stranded tinned copper conductor, insulation of EPR (Ethylene-propylene Rubber) each individual core protected and covered and overall outer cover of poly-chloroprene rubber cable will conform to IS 9968 part-1.

VOLUME- IV
SECTION-17,
ILLUMINATION

TABLE OF CONTENTS

1. GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport to site of Illumination System complete with luminaries and all accessories for efficient and trouble-free operation of 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2. CODES AND STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

IS 3646 (Part I to III)	:	Code of Practice For Interior Illumination
CBIP Manual	:	Substation Equipment, Illumination and Layouts
IES (Illuminating Engineering Society of North America)	:	Application and Reference Volume
IEC 60598	:	Luminaires
IEC 60081	:	Double Capped Fluorescent Lamps
IEC 60920 & 60921		Ballast for Tubular Fluorescent Lamps
IEC 60400		Lampholder for Tubular Fluorescent Lamps & Starter Holder
IEC 60064		Tungsten Filament Lamp for Domestic And Similar General Purpose
IEC 60188		High Pressure Mercury Vapor Lamps

Indian Electricity Rule (IE) 1956 as amended up to date.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted will have to be submitted along with the bid.

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

Areas to be covered in TG package are entire Power House Building including BMCC room, Transformer Yard, Adjoining roads, DG Plant Building, Service Building, ACW Pump House, Switchgear/MCC rooms, piping gallery, CPU Regeneration plant, cable gallery, all roads within battery limit and area illumination of the above premises.

Any other area/premises not specifically mentioned here, but which fall under the battery limit of this package are included in the scope.

The following equipment and materials are broadly covered under this scope.

Lighting Transformers, Main lighting boards, Emergency lighting boards, Emergency DC lighting panels, Lighting panels/boards, Street lighting panels etc.

Lighting fixtures with lamps and accessories.

Street light poles and High Mast towers.

Ceiling fans, receptacles, switches, switchboards, portable emergency lights, portable 24V supply module including handset maintenance equipment and required extension cable etc.

Cable trays and supporting structures

Cables, wires, splicing/termination/connection accessories.

Conduit and accessories, junction and pull boxes, terminal blocks.

Grounding materials and connections.

All fittings, supports, brackets, anchors, clamps and connections.

Steel for field fabrication of supports and brackets

Welding sockets with Welding DB

3. DESIGN CRITERIA

The illumination system will provide lighting supply to all plant areas. In addition, it will also provide emergency lighting to selected areas during plant emergency conditions, as described below.

The entire illumination system will be installed in an adverse industrial environment. Fixtures / Accessories in some areas will be subject to vibration, coal dust, oil/water vapors as prevalent in a Thermal Power Plant.

The design will be such so to ensure the minimum lighting levels as specified for different areas.

The illumination system will comprise of following sub-systems:

Normal A.C. Lighting

This will be provided by A.C. lighting fixtures distributed throughout the plant. These lights will be ON as long as the station A.C. supply is available. A.C. lighting fixtures will be fed from respective area A.C. Lighting Panels, which in turn will be connected to Main Lighting Distribution Boards (MLDB). The Main Lighting Distribution Boards will be fed from through 415V/433V Lighting transformers.

In CPU regeneration Plant area, MLDB will be fed from respective LT switchgear/MCC.

Emergency A. C. Lighting

On failure of normal AC supply, emergency AC lighting will be provided in selected areas of the Powerhouse, TG areaand some other areas close to the powerhouse for general visibility, safe movements & operation of major equipment and auxiliaries. Emergency AC lighting fixtures will be fed from respective Emergency AC Lighting Panels. These panels will be fed from the Emergency AC Lighting Distribution Board (ELDB). The Emergency Lighting Distribution Board (ELDB) will be fed from 415V Emergency switchgear having D.G system backup through 415V/433V lighting transformers.

20% of the total fittings will be fed from Emergency lighting for areas such as TG Area,control rooms etc. AC emergency lights will operate during normal conditions also.

Two nos 415 V feeders will be made available from the 415 V Emergency (N/E) switchgear.

Emergency D.C. Lighting

The Emergency DC Lighting System will be located strategically in critical operating areas and at emergency exits. Emergency DC lighting will also be provided in the Control rooms, Switchgear/ MCC rooms and other strategically important areas. These fixtures will be fed from respective Emergency DC Lighting Panels. The Emergency DC Lighting Boards (DCELDB) will be fed from 220V DC Distribution Boards (DCDB). 10% of the total fittings will be fed from Emergency D.C. Lighting. for areas such as TG area, area and Control rooms etc.

These lights will remain normally OFF but on failure of AC supply these lights will be automatically ON. Tube lights with Electronic choke suitable for 230 V, AC / DC operation or other Energy Efficient Lamps may be used for DC emergency lighting.

24 V Maintenance Sockets with necessary step-down Transformer will be provided at Strategic locations such as TG Hall areas and Switchgear rooms etc.,

Emergency Lighting with self contained batteries

This system will be provided by portable self-contained battery / automatic charger / inverter fed compact fluorescent lamps in isolated buildings / areas where station D.C. supply is not available. These portable emergency light units will be switched on automatically on loss of normal AC supply. Battery packs for portable emergency lights will be rated for minimum two and half hour duty.

Watch Tower / Street Lighting /Area Lighting

Time-switch with inbuilt battery backup and/or photocell will be used for controlling street lights/area lights with provision for manual over-ride.

Illumination Calculation

Standard Lumen method will be adopted for interior and exterior lighting in order to determine the number of lighting fixtures for obtaining the desired average level of illumination.

The coefficient of utilization will be considered to take care of Lumen loss due to:

a) Effect of room dimensions.

b) Absorption of light in luminaries.

c) Absorption of light at various room surfaces i.e. ceiling wall etc.

d) Floor cavity, ceiling cavity.

e) Mounting height.

Moreover a maintenance factor will also be considered to account for the fall of illumination due to aging, pollution like dust deposits etc.

Voltage drop at the fixture terminals from the MLDB bus will not exceed 3%. Circuit loading of each lighting Panel will be done in such a way that almost balanced loading in all the phases i.e. R, Y and B is achieved. At least two sub circuits will be used for illumination of a particular area. Sub circuit loading of each lighting panel will be restricted to 2000 Watts.

Design of lighting system will be such that the average lux level specified is achieved. . These lights will remain normally off , but on failure of AC supply these lights will be automatically on. Maintenance light (24 Volt) would be used for maintenance purpose.

Hand lamps

10 nos. 24 V halogen lamps with reflector along with 1100 V, twin core PVC sheathed, 2.5 mm2 stranded copper wire of 20 m lengths as handset will be supplied loose.

ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES

The area-wise average illumination levels and type of luminaries will be as indicated below:

S No.	Location	Lighting Fixture Type	Lux Level
1	Control Rooms	Energy Efficient FTL in Decorative fittings with wide angle mirror optic antiglare reflector. Decorative Compact fluorescent tube (CFL) fitting with internal mirror reflector with mounting bracket suitable for 1x18W/ 1 x 22W/ 1x25W lamps.	400
2	Testing Laboratories	Energy Efficient FTL in Decorative fittings with wide angle mirror optic antiglare reflector.	

S No.	Location	Lighting Fixture Type	Lux Level
		Decorative Compact fluorescent tube (CFL) fitting with internal mirror reflector with mounting bracket suitable for 1x18W/ 1 x 22W/ 1x25W lamps.	400
3	Turbine Hall	400W HV SV high beam flame proof well glass fixture	200
4	Compressor Plant	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	200
5	DG Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	200
6	Pump House	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	200
7	Battery Room	Energy efficient 2X40 W FTL industrial type corrosion proof with vitreous enamel finish (pendant / bracket mounting	250
8	Air Conditioning Plant Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	200
9	AHU Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	200
10	Switchgear/MCC/Electrical & Electronic equipment Rooms	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	250
11	Elevator M/C Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting	200
12	Office room	Decorative recessed type energy efficient 2 x 40 FTL with mirror reflector Decorative Compact fluorescent tube (CFL) fitting with internal mirror reflector with mounting bracket suitable for 1x18W/ 1 x 22W/ 1x25W lamps. For rooms without false ceiling, surface mounted fixtures will be used.	300
13	Cable spreader Area	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish	100
14	Oil Room and indoor hazardous areas	1 x 70 W HPMV Flame proof well glass fixture	150
15	Passage, Indoor Stair	Energy efficient 2x40 W FTL industrial	100

S No.	Location	Lighting Fixture Type	Lux Level
	case , Toilet etc	type with vitreous enamel finish	
16	Outdoor/Semi outdoor stairs/ Transformer Yard	Dust & weather proof 70 W HPSV well glass fitting with reflector and integral mounted control gear.	70
17	Street & periphery lighting	150W HPSV street light fittings	20
18 (a)	Control Room	DC emergency lighting Energy efficient 2x40W FTL industrial type of vitreous enamel finish and with electronic choke suitable for 220V DC operation.	400
18 (b)	Other areas	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish and with electronic choke suitable for 220V DC operation.	

4. SPECIFIC REQUIREMENTS

4.1 Equipment and Material

- Equipment and material will comply with description, rating, type and size as detailed in this specification.
- Equipment and materials furnished will be complete and operative in all details.
- All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment will have to be furnished.
- All parts will be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment will be inter-changeable.

4.2 Lighting Fixtures and Lamps

- Fluorescent fixtures with electronic ballast will be generally provided for a room height upto 5m. Type of fixture will be industrial type with gasket, clear acrylic cover and enamelled reflector or decorative type to suit the aesthetics. For areas with false ceiling , recessed mounted decorative fixtures with mirror optic louvres will be used. In control room / computer rooms, decorative mirror optic fluorescent light fittings with antiglare features will be provided. The surface finish will be smooth, unobtrusive and scratch resistant.
- Reflector will be of sheet steel or aluminium, minimum 20 SWG thick and securely fixed by fastening device of captive type.

- Fixture will be suitable for 19 mm conduit entry and 16 SWG GI earth wire connection.
- Fixture will be furnished complete with lamps and integrally mounted accessories. These will include holders, ballast, capacitor, starter, ignitors (separate type) etc.
- For corrosive areas, corrosion proof lighting fixture will be provided. For hazardous areas, light fittings, conduits, junction boxes etc. will have to meet the corresponding area classification requirement.
- Medium bay or high bay type of lighting fixtures with HPMV/HPSV lamps will be used depending on the mounting heights for indoor areas having room height more than 5m. Medium/ High bay fixtures will be provided with vibration damper wherever required.
- For areas like boiler and outdoor areas such as roads, street, transformer areas and open yards, weatherproof HPSV flood/ street lighting fixtures will be used. For areas like boiler platforms, weatherproof well glass type HPSV fixtures with wire guards will be used.
- All type of fluorescent lamps including Compact Fluorescent Lamp (CFL) will be bi-pin rotary type and either cool daylight or white.
- Mercury / Sodium vapour lamp will be colour corrected type with screwed cap.
- Lamps will be suitable for use in position and capable of withstanding small vibrations.
- Ballasts will be of heavy duty, low loss and polyester-filled type with copper winding.
- Ballasts for Mercury / Sodium vapour lamps will be provided with suitable tappings to set the voltage within range specified.
- Ballasts will be free from hum. Ballasts which produce humming sound will be replaced, free of cost.
- In multi-lamp fixture, each lamp will be provided with individual ballast.

4.3 Receptacles

- Receptacles will be heavy duty, complete with individual plug and switch as described below:

Sl.No.	Type	Description
1.	RA	5A, 230V, 2 Pole, 3 Pin with third pin earthed - Suitable for flush mounting in office areas and control room. The switch will also be flush mounting piano type.
2.	RB	15A, 230V, 2 Pole, 3 Pin with third pin earthed - Wall/ column mounted, metal clad gasketed construction, suitable for 19 mm conduit entry, screwed metal cover tied with metal chain, weatherproof construction suitable for indoor/outdoor installation. This will be provided at an interval of 30m, or minimum one in each room.

Sl.No.	Type	Description
3.	RC	63A, 415V, 3 Phase, 5 pin interlocked plug and switch with fifth pin earthed. Wall/column mounted, metal clad gasketed construction weather proof, suitable for loop in/ loop out connection of 4 Core 35 sq.mm AYWY cable. These receptacles will be provided at an interval of 50m throughout the Plant Area.
4.	RD	100A, 415V, 3 phase, 5 Pin interlocked plug and switch with fifth pin earthed Wall/column mounted metal clad gasketed construction weather proof, suitable for loop in/ loop out connection of 3.5 Core, 95 sq.mm AYWY cable.

- The conduit box of the receptacle will be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG GI wire. Arrangement will be provided inside the conduit box for grounding of third pin.
- Shrouded type plug will be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.
- Lighting Distribution Boards and Lighting Panels will be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors will have padlocking arrangements.

4.4 Main Lighting Distribution Boards/Lighting Panel / Distribution Boards

- The Main Lighting Distribution board will be fed from Lighting Service Switchgear through 415V/433V lighting transformers with off circuit taps ± 5% in steps of 2.5%. The lighting transformer will be encapsulated cast resin dry type and will be housed in a suitable enclosure. The main lighting distribution boards will consist of two incoming MCCB/SFU with a bus coupler and required number of out going feeders consisting of triple pole and neutral SFUs/MCCB. The board will be designed for the required short circuit level of 20 kA. All the distribution boards will be sheet steel metal clad, dust and vermin proof, cubicle type with degree of protection conforming to IP-52. Outdoor panels will be weather proof type with IP-54 protection. The thickness of sheet steel enclosures will be 2 mm minimum for load bearing and 1.6 mm for other members.
- The lighting panels will be rated for 415 V, 3 phase, 4 wire, AC with neutral bus and suitable for either wall/column mounting. Indoor panels will have degree of protection of IP 52 and the outdoor panels will have a degree of protection of minimum IP 55. Additionally, all outdoor panels will be provided with detachable canopy at the top with regular slope towards the rear to prevent accumulation of rain water.
- The panel bus bars will be of electrolytic grade Hard drawn Aluminium, sized for a maximum temperature of 40°c over the ambient temperature,

colour coded for easy identification of phase and neutral bus bars. Minimum size will be 25x6mm

- The cable/conduit entry may be either from the top or bottom (for Indoor Panels) / from bottom only (for Outdoor Panels) with removable cable gland plates and will be terminated in suitable separate terminal blocks. Necessary double compression type brass cable glands, tinned copper cable lugs are to be provided.
- Provision will be made for earthing the panel at two points. A copper earth bus will run along the length of the panel. The front access door of the panels will have padlocking arrangement.
- The incoming to each Normal and Emergency AC Lighting Panel will be provided with a triple pole MCB with neutral isolating facility and one earth leakage circuit breaker. Combined type triple pole MCB and earth leakage circuit breaker (ELCB) are also acceptable for incomers to Lighting Panels.
- Normal and Emergency AC lighting panels will have outgoing MCBs having thermal elements for overload protection and an instantaneous magnetic trip to protect against severe faults. All MCBs provided will be suitable for breaking capacity of 9 kA (minimum) at 230 V AC.
- The Emergency DC Lighting Panels will have Incoming and outgoing feeders with HRC Switch fuse units or MCB units with back up fuse as required.
- The Lighting Panels will be of double door type with the outer enclosure made of sheet steel having a minimum thickness of 2 mm with a hinged door and suitable locking arrangement.
- Each of the MLDBs/ ELDBs will be provided with voltmeter and ammeter along with selector switches, 'SUPPLY ON' indicating lamps, etc.
- The incomers of Main and Emergency AC Lighting Distribution Boards (MLDB & ELDB) will be provided with energy (kWh) meter for measurement of energy consumed by the lighting loads. The energy meters will be 3 phase, 4-wire type suitable for measurement of unbalanced loads.
- Each outgoing MCB will be of 15 A, but load to be limited to 2 kW or maximum 10 nos. fittings to be connected to one MCB.
- Individual control in office buildings will be through single pole flush type switches. In those areas where group controls are required, rotary switches/MCBs will be provided.
- Lighting panels feeding the boiler area will be provided with contactors for control from a remote point. Lighting fixtures of boiler area platforms will be fed from different circuits such that all the lights in the area are not 'On' all the time. The lights connected to a circuit or few circuits will be 'ON' automatically through photocell. Provision will be made for switching 'ON' for rest of the lights. In heat zones, ie; in the areas where ambient temperature is 60 deg C and above, heat resistant control cables will be used in hot dip galvanized rigid steel surface

- Each Lighting Distribution Board will be complete with designation and caution notice plates fixed at front cover and a directory plate fixed inside the front cover. This directory plate will contain details of the lighting panels being fed from the Distribution Board including their designation, location, loading etc. Each Lighting Panel will be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate will contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of the circuit. The plates will be of anodised aluminium with inscriptions indelibly etched on it. Each Lighting Distribution Boards will be painted as stated in Clause No. 4.15. For street lighting, 3-phase power from MLDB will be supplied by 3 nos. single pole MCB. The circuit will be looped in and out at each lighting pole through a Junction box and Tee off will be provided with single pole MCB for supply of power to the fixture of that lighting pole.
- Number of outgoing feeders in MLDB's, SLDB's will be provided as per requirement. Feeders for Purchaser's use and 20% spare feeders of each type and rating will be provided in MLDB, LDBs/SLDBs.

4.5 Lighting Transformer

- Lighting transformers will be three phases, delta/star, 415 V/433 V, air cooled, Encapsulated epoxy cast resin insulated dry type. Secondary neutral will be solidly earthed.
- Lighting transformers will be provided with Off load tap switch/link with change of ± 5% in step of 2.5% tapping full capacity. Insulation class will be 'F' with temperature rise limited to Class B.
- KVA rating : 100 KVA (min)

  Vector Group : Dyn11

  Maximum Temperature rise over

  50 Deg C ambient in winding by resistance : 90 Deg.C

  Neutral : Solidly grounded.

- The secondary neutral of the transformer will be brought out for getting a grounded 4 wire supply. Each transformer will be routine tested in the presence of Purchaser or his representative. Type test conducted for similar type of Transformers will be furnished for approval.
- The transformer will be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.
- The transformer will be mounted inside sheet steel enclosure with IP23 protection.

4.6 Fittings and accessories for lighting Transformers

Each transformer will be equipped with fittings and accessories as listed below 50 mm dia. winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip and alarm.

Handling and lifting lugs both for enclosure and core-coil assembly.

Jacking pad for core-coil assembly.

Inspection cover for cable end box.

Door handle operated safety limit switch with 1NO + 1NC contact.

Necessary earthing.

Rating and terminal marking plates.

Note: All indication, alarm, trip contacts provided will be rated for 0.5A at 220 V D.C. and 5A at 240 V A.C

4.7 Fans and Regulators

- The fans will have three well balanced blades, double ball bearings and will be reasonably free from noise. Fan motor will be totally enclosed type with copper winding and class-E insulation. Sweep will be given as 1200 /1400 mm.
- Regulators will have minimum five steps. Electronic Regulators with smooth control will be provided.

4.8 Switch and Switchboard

- All switch boards/boxes will be of folded steel sheet construction, fabricated of 14 SWG MS sheet with 6 mm thick Bakelite front cover and brass fixing screws.
- Each Switchboards will be painted in accordance to Clause No. 4.15
- Switchboards/boxes located in control room and office areas will be flush mounted type on brick wall with only the switch knob projecting outside.
- Switch boards/boxes will have conduit knock outs on the sides. Adequate provision will be available for ventilation of these boxes.
- At least one 5/15A flush type receptacle will be provided in each switchboard and so located that only the plug projects outside.
- Switches will have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

4.9 Lighting Poles / Towers

Street Light Poles

Street light poles will be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.

All poles and hardware will be hot dip galvanised. Galvanisation will be done in accordance to Clause No. 4.17.

5. HIGH MAST TOWERS

5.1 GENERAL

The scope of covers the manufacture, transport, installation, testing and commissioning of the complete lighting system, using Raising and Lowering type of High mast Towers, including the Civil Foundation Works. All items required for the safe and efficient operation and maintenance of the lighting system, including the high mast, whether explicitly stated in the following pages or not, will be included by the Tenderer. However, the minimum height of lighting mast will be 20 meters with six numbers 2X400W HPSV lamps.

Structures

The High mast will be of continuously tapered, polygonal cross section, at least 20 sided, presenting a good and pleasing appearance and will be based on proven In-Tension design conforming to the standards referred to above, to give an assured performance, and reliable service. The structure will be suitable for wind loadings as per IS 875 Part 3 1987.

Construction

The mast will be fabricated from special steel plates, cut and folded to form a polygonal section and will be telescopically jointed and welded. The procedural weld geometry and the workmanship will be exhaustively tested on the completed welds. Mast can be fabricated in multiple sections. No site welding or bolted joint will be done on the mast. The minimum over lap distance will be 1.5 times the diameter at penetration. The dimensions of the mast will be decided based on proper design and design calculations will be submitted for verification.

The mast will be provided with fully penetrated flange, which will be free from any lamination or incursion. The welded connection of the base flange will be fully developed to the strength of the entire section. The base flange will be provided with supplementary gussets between the bolt holes to ensure elimination of helical stress concentration. For the environmental protection of the mast, the entire fabricated mast will be hot dip galvanized, internally and externally, having a uniform thickness of 85 microns for the bottom section and 65 micron for the middle and top sections.

Door opening:

An adequate door opening will be provided at the base of the mast and the opening will be such that it permits clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch. The door opening will be complete with a close fitting, vandal resistant,

weatherproof door, provided with a heavy-duty double internal lock with special paddle key.

The door opening will be carefully designed and reinforced with welded steel section, so that the mast section at the base will be unaffected and undue buckling of the cut portion is prevented. Size of door opening will be strengthened if required to avoid buckling of the mast section under heavy wind conditions.

Dynamic Loading for the Mast:

The mast structure will be suitable to sustain an assumed maximum reaction arising from a wind speed as per IS 875 (three second gust), and will be measured at a height of 10 metres above ground level. The design life of the mast will be a minimum of 25 years.

Lantern Carriage:

Fabrication:

A fabricated Lantern Carriage will be provided for fixing and holding the flood light fittings and control gearboxes. The Lantern Carriage will be of special design and will be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets. The Lantern Carriage will be so designed and fabricated to hold the 12 numbers of flood light fittings and the control gearboxes, and also have a perfect self-balance.

The Lantern Carriage can be fabricated in two / three segments and joined by bolted flanges with stainless steel bolts and nylon type stainless steel nuts to enable easy installation or removal from the erected mast. The inner lining of the carriage will be provided with suitable protective arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage. The entire Lantern Carriage will be hot dip galvanised after fabrication. The design will provide a perfect balance for the lantern carriage during raising and to lowering also.

Junction Box

Weather proof junction box, made of Cast Aluminium will be provided on the Carriage Assembly as required, from which the inter-connections to the designed number of the flood light luminaries and associated control gears fixed on the carriage, will be made.

Raising and lowering mechanism:

For installation and maintenance of the luminaries and lamps, it will be necessary to lower and raise the Lantern Carriage Assembly. To enable this, a suitable Winch Arrangement will be provided, with the winch fixed at the base of the mast and the specially designed head frame assembly at the top. Suitable provision/ end limit switches will be provided to trip the winch motor at both top & bottom ends of the designed travel.

Winch:

The winch will be of completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch will be positively locked when not in use, gravity activated PAWLS. Individual drum also should be operated for fine adjustment of lantern carriage. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch will be clearly marked on each winch.

The winch will be self-lubricating type by means of an oil bath and the oil will be readily available grades of reputed producers.

The winch drums will be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. The rope termination in the winch will be such that distortion or twisting is eliminated and at least 5 to 6 turns of rope remains on the drum even when the lantern carriage is fully lowered and rested on the rest pads. It should be possible to operate the winch manually by a suitable handle and by an external power tool. It will be possible to remove the double drum after dismantling, through the door opening provided at the base of the mast. Also, a winch gearbox for simultaneous and reversible operation of the double drum winch will be provided as part of the contract.

The winch will be type tested in presence of a reputed Institution and the test certificates will be furnished before supply of materials. A test certificate will be furnished by the Tenderer from the original equipment manufacturer, for each winch in support of the maximum load operated by the winch.

Head Frame:

The head frame, which is to be designed as a capping unit of the mast, will be of welded steel construction, galvanised both internally and externally. The top pulley will be of appropriate diameter, large enough to accommodate the stainless steel wire ropes and the multi-core electric cable. The pulley block will be made of non-corrodable material, like die cast Aluminium Alloy (LM-6). Self-lubricating bearings and stainless steel shaft will be provided to facilitate smooth and maintenance free operation for along period. The pulley assembly will be fully protected by a canopy galvanised internally and externally.

Close fitting guides and sleeves will be provided to ensure that the ropes and cables are not dislodged from their respective positions in the grooves. The head frame will be provided with guides and stops with PVC buffer for docking the lantern carriage.

Stainless Steel Wire Ropes:

The suspension system will essentially be without any intermediate joint and will consist of only non-corrodible stainless steel of AISI 316 or better grade.

The stainless steel wire ropes will be of multi strand construction, the central core being of the same material. The overall diameter of the rope will not be less than 6 mm. The breaking load of each rope will have factor of safety of over 5 for the system at full load. The end constructions of ropes to the winch drum will be fitted with talurit.

The thimbles will be secured on ropes by compression splices. Two continuous lengths of stainless steel wire ropes will be used in the system and no intermediate joints are acceptable in view of the required safety. No

intermediate joints / terminations, either bolted or else, will be provided on the wire ropes between winch and lantern carriage.

Electrical System, Cable and Cable Connections:

A suitable terminal box will be provided as part of the contract at the base compartment of the high mast for terminating the incoming cable. The electrical connections from the bottom to the top will be made by special trailing cable. The cable will be EPR insulated and PCP sheathed to get flexibility and endurance, and have copper conductors. The cable will be of reputed make. At the top there will be weatherproof junction box to terminate the trailing cable. Connections from the top junction box to the individual luminaries will be made by using 3 core flexible PVC cables of adequate size. The system will have in-built facilities for testing the luminaries while in lowered position.

Also, suitable provision will be made at the base compartment of the mast to facilitate the operation of externally mounted, electrically operated power tool for raising and lowering of the lantern carriage assembly. The trailing cables of the lantern carriage rings will be terminated by means of specially designed, metal clad, multi pin plug and socket provided in the base compartment to enable easy disconnection when required.

A distribution board with suitably rated 3 phase incomer MCB and separate MCB's controlled feeders for lighting and power tool will also be supplied. The board will incorporate photo electric cell for control of lighting and control circuit for winch operation with all necessary contactors on incoming / outgoing feeders etc. as required. The board will have IP 55 protection with rainwater protections canopy and epoxy powder coated suitable for out door mounting in coastal area. The work will also include necessary foundation cable glands etc. complete as required. The whole board and few O/G feeders (if required) will be able to control from PLC apart from local DB.

Power Tool for the Winch:

A suitable, high-powered, electrically driven, internally mounted power tool, with manual over ride will be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The speed of the power tool will be to suit the system. The power tool will be single speed, provided with a motor of the required rating. The power tool will be supplied complete with push button type remote control switch, together with 6 (six) metres of power cable, so that the operations can be carried out from a safe distance of 5 (five) metres. The capacity and speed of the electric motor used in the power tool will be suitable for the lifting of the design load installed on the lantern carriage.

The power tool mounting will be so designed that it will be not only self supporting but also aligns the power tool perfectly with respect to the winch spindle during the operations. Also, a handle for the manual operation of the winches in case of problems with the electricity operated tool, will be provided and will incorporate a torque limiting device.

There will be a separate torque-limiting device to protect the wire ropes from over stretching. It will be mechanical with suitable load adjusting device. The torque limitor will trip the load when it exceeds the adjusted limits. There will be suitable provision for warning the operator once the load is tripped off. The torque limitor is a requirement as per the relevant standards in view of the over all safety of the system. Each mast will have its own power tool motor.

Lightning Finial:

One number heavy duty hot dip galvanised lightning finial will be provided for each mast. The lightning finial will be minimum 1.2 M in length or as required so that the lantern carriage also comes within the safety zone and will be provided at the center of the head frame. It will be bolted solidly to the head frame to get a direct conducting path to the earth through the mast. The lightning finial will not be provided on the lantern carriage under any circumstances in view of safety of the system.

Aviation Obstruction Lights:

Neon type Aviation Obstruction Lights of reliable design and reputed manufacturer will be provided on top of each mast.

Earthing Terminals:

Suitable earth terminal using 12 mm diameter stainless steel bolts will be provided at a convenient location on the base of the Mast, for lightning and electrical earthing of the mast. The mast will be provided with duplicate earthing including necessary earth pits as per IS.

Foundation for high mast

The scope also includes supplying all materials and casting of RCC foundation along with necessary Anchor bolts etc.

The detailed drawing for the foundation will be submitted and got approved by/owner consultant before starting of the work.

Luminaries

Luminaries will be specially designed with suitable lamp housing and control gears. The luminaries will be tested as per Indian standards and test reports will be submitted for approval. The luminaries will be suitable for installation on high masts. The number and type of light fitting will be as required / Approved BOQ.

5.2 Maintenance Equipment

- One (1) no. of wheel mounted adjustable telescopic aluminium ladder for maintenance of street lights will be provided.
- For the maintenance of lighting fixtures within the power house, four (4) nos. free standing adjustable telescopic aluminium ladder, adjustable from 5m to 10m & two (2) nos. adjustable aluminium ladders, adjustable from 0.5m to 1.5m will be provided.

5.3 Lighting Cables and Wires

- Lighting Cable will be heavy duty, 660/1100 Volt grade, multicore stranded aluminium conductor, XLPE insulated, extruded PVC inner sheath, single round GI wire armoured and overall FRLS PVC sheathed to IS 7098 Part I.
- Lighting wires will be 660/1100 Volt grade, PVC insulated, stranded conductor, inner sheathed, single core cable to IS 694: Minimum size of cable/wires will be 2.5 mm sq. copper.

5.4 Conduits and Accessories

- Conduits will be of rigid steel, hot-dip galvanized, furnished in standard length of 3 meters, threaded at both ends.
- Conduits upto and including 25mm will be of 14 SWG. Minimum size of conduits will be 19 mm.
- Each piece of conduits will be straight, free from blister and other defects and covered with capped bushings at both ends.
- Flexible conduits will be made with bright, cold rolled annealed and electro-galvanized mild steel strips and coated with PVC.

5.5 Lighting Junction Box

- The junction boxes will be of sheet metal, dust and damp proof, generally conforming to IP 55.
- The junction boxes will be complete with gasketted inspection cover, conduit knock out/ threaded hub/ cable entry and terminal blocks.
- Junction boxes for outdoor use will weatherproof IP-55 and those for hazardous location will be flame proof type.
- Junction Boxes will have following indelible markings:

a. Circuit nos. on top.

b. Circuit nos. with ferrules (inside) as per drawing.

c. Danger sign in case of 415V circuit.

5.6 Terminals

- Multiway terminal blocks complete with screws, nuts, washers and marking strips will be furnished for connection of incoming/outgoing wires in the junction boxes.
- Each terminal will be suitable for connection up to two (2) nos. 2.5 mm2 copper conductors.

5.7 Name Plate

Name plates will be furnished for identification of devices and circuits. All switches, controls and indications will be permanently and legibly marked in english regarding the functions.

5.8 Painting

All surfaces will be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

After cleaning, the surfaces will be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

The equipment will be finished in approved color shade by owner with two coats of epoxy based powder coated paint. The coating will be done electro statically followed by stoving.

Sufficient quantity of touch-up paint will be furnished for application at site.

5.9 Hot Dip Galvanizing

Wherever applicable, the minimum weight of the zinc coating will be 900 gm/sq.m and minimum thickness of coating will be 85 microns for items thicker than 6 mm. For items lower than 6mm thickness requirement of coating thickness will be as per relevant ASTM. For surface, which will be embedded in concrete, the zinc coating will be 900-gm/sq. minimums.

The galvanized surfaces will consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface will be clean and smooth and will be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection will render the material liable to rejection.

After galvanizing no drilling or welding will be performed on the galvanizing parts of the equipment except that nuts may be threaded after galvanizing. Sodium dichromate treatment will be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel will be subjected to six one-minute dips in copper sulphate solution as per IS-2633. Sharp edges with radii less than 2.5 mm will be able to withstand four immersions of the Standard Preece test. All other coatings will withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site will not be allowed.

5.10 Samples

Owner reserves the right to call for samples if considered necessary and the same will be submitted free and without any obligation.

6. TESTS

6.1. Shop Tests

All equipment will be completely assembled, wired, adjusted and routine tested as per relevant IEC Standards at manufacturer's works.

Tests on Lighting Distribution Boards / Panels will include:

a) Wiring continuity tests.

b) High voltage and insulation tests.

c) Operational tests.

6.2. Test Witness

All tests will be performed in presence of owner's representative, if so desired by the owner.

The Contractor will give an advance notice of shop tests and tests.

6.3. Test Certificates

- Certified copies of all tests carried out at works and at site will be furnished in requisite no. of copies for approval of the Owner.
- The equipment will be dispatched from works only after receipt of Owner's written approval of shop test reports.
- Valid Type test certificate on any equipment (within last 5 years), if so desired by the Owner, will be furnished. Otherwise the equipment will have to be type tested, free of charge, to prove the design.

7. DRAWINGS, DATA & MANUALS

Drawings, data and manuals will be submitted in quantities and procedures as specified in the General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

Drawings, Data and Manuals to be submitted for approval

Detail dimensional drawing showing constructional features, cable/ conduit entry, grounding, fixing arrangement etc. of:

a) Lighting panels & distribution boards.

b) Receptacles & Junction boxes.

c) Street light poles & towers.

d) Lighting fixture complete with lamps and accessories.

e) Non-integral/separate type control gear box for lighting fixtures, as applicable.

f) Lux level calculations for each area.

g) Data sheets for lighting fixture, lamps, accessories with light distribution curves, co-efficient of utilization charts etc. Type and routine test certificates of transformer and cables.

h) Control schematic and wiring diagram of 415V AC/220V DC lighting panel with automatic changeover from AC to DC and vice-versa, 415V normal AC street/area lighting panel with automatic ON/OFF feature.

i) Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of transformer and cables.

j) QAP and relevant test certificates

k) Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire routing.

l) Key Single Line Diagram for lighting distribution, board wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.

Note:

- AS-BUILT lighting layout and erection drawings, properly incorporating the changes/alterations/field modifications, if any, as carried out at field along with circuit distribution schemes of all lighting panels, conduit and cable routing and as acceptable to the Owner.

- Any other relevant drawings, data and manuals necessary for satisfactory installation, operation and maintenance.
- The Contractor may note that the drawings, data and manuals listed are minimum requirement only. The Contractor will ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted.

VOLUME- IV
SECTION-18,
GROUNDING & LIGHTNING PROTECTION

TABLE OF CONTENTS

1 GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site and delivery Grounding and Lightning system complete with all accessories for efficient and trouble-free operation of 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2 CODES AND STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification. All standards, specifications and codes of practice referred to herein will be the latest editions including all applicable official amendments. All work will be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear

IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels – recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.

BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type, for Aluminum conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.
	National Electrical Code, 1985.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, , VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Contractor will clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments.

3 GROUNDING & LIGHTNING PROTECTION

3.1 General

The main objectives of grounding system are to :

a) Provide safety to personnel from contact of dangerous potential caused by ground fault.

b) Ensure sufficient grounding current for effective relaying.

c) Stabilize circuit potential with respect to ground.

3.2 Grounding system

In order to meet the above objectives, ground grid mesh will be provided for the entire area within battery limit.

Fault current for the earthing system will be designed for 50 KA for a duration of 1 sec.

All electrical equipment, non current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

Treated earth pits including riser will be provided for Transformer neutral earthing.

Connection between the equipment earth lead and the grid conductor will be welded. For rust protection, the welds will be treated with zinc chromate primer and coated with zinc rich paint.

Entire erection of grounding work will be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.

The major aspects to be considered for grounding system design are given below:

3.3 Ground Grid Conductor

a) Ground grid conductor of mild steel rod will be used.

b) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm (on diameter of conductor) per year over the design life of at least 30 years.

3.4 Underground Grid

a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80.

b) The ground grid conductors will be buried in earth at a depth of 600 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than one (1) ohm.

c) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.

d) Ground rods will be provided at the points where system neutrals/lightning protections are connected to the ground grid.

e) All ground grid conductor connections will be welded type.

f) Ground grid will be interconnected with the ground grid of neighboring areas at least at two (2) points for further reducing the ground grid resistance.

g) Suitable pigtails will be provided and shown in the layout drawing for connection with ground grid of neighboring areas.

h) A minimum earth coverage of 300 mm will be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes, foundations, railway tracks etc. The ground grid

conductor will be re-routed in case it fouls with equipment foundations.

i) In some cases, it may happen that the construction work of cable trench, foundation and laying of underground pipes are being taken up after the grounding mat has been laid. It may be required to cut a portion of grounding conductor to avoid fouling with cable trench, equipment foundations, underground pipes etc. In this case, the ground conductor will be properly rerouted and rejoined/reconnected with the main grounding mat during the construction/laying of above underground objects and good electrical continuity of grounding conductor will be ensured.

j) Grounding conductors crossing the road may have to be laid at greater depth to suit the site conditions.

k) Grounding conductor around the building will be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.

l) The Contractor will carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc.

3.5 Ground Electrode

Ground electrodes will be 40 mm dia and 3 metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductors. All connections to the conductors will be done by arc welding process.

3.6 Above Ground Connections

a) Galvanised steel flats will be used for all connections above earth.

b) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.

c) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.

All connections above ground will be welded type except connection to equipment/structures which will be bolted type.

3.7 Column Grounding

All steel columns and structures will be connected to the earth mat through 40 mm dia M.S. rods. All welded joints will be painted to protect from rusting.

3.8 Risers

Risers are required for connecting the equipment and structures with the ground mat. Risers are to be provided from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be 1 No. 40 mm dia. M.S. rod and will project above grade level/concrete floor level by minimum 300 mm. They are to be clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat will be done by arc welding.

3.9 Equipment Ground Lead

Equipment ground connections will be sized to carry the ground fault current. Considerations will also be given to mechanical ruggedness of the connections and to limit the number of sizes.

The minimum ground conductor sizes for various equipment and structures are given in below.

DESCRIPTION	SIZE	MATERIAL
a) Main Grounding Grid Conductor	40 mm dia Rod	Mild Steel
b) Riser/Pigtail From Grounding Grid/Mat	40 mm dia Rod	- Do -
c) Electrode	40 mm dia,3000 mm long Rod	- Do -
d) Conductor used for connection of various equipment/structures as listed below		
HT motors, Earthing ring, Earthing lead to earth pits etc.	75 x 5 mm	Galvanised steel
Structures, Control Panels, Cable Trays etc.	50 x 6 mm Flat	- Do -
415V Power Control Centres, Motor Control Centres, Distribution Boards etc.	50 x 6 mm Flat	- Do -
Local Panels, Lighting Panels	35 x 6 mm Flat	- Do -
Motors :		
Above 90 kW	50 x 6 mm Flat	Galvanised steel
Above 30 kW Upto 90 kW	25 x 6 mm Flat	- Do -
Above 5 kW Upto 30 kW	25 x 3 mm Flat	- Do -
Upto 5 kW	8 SWG	- Do -
Miscellaneous Items, viz. Push Button Station, Junction Boxes etc	8 SWG	- Do -

50 x 6 mm galvanised steel flats(minimum size) will be run as main earthing conductors above ground along building columns, walls, steel structure, etc. for equipment and other structures earthing. These earthing conductors will be interconnected between them and to the main ground grid through risers/pigtail. The connection between earthing conductor and riser will be made above ground. Earthing conductors along their run on column, wall etc. will be supported by suitable welding/clamping at intervals set exceeding 750 mm.

Earthing conductors can be embedded in concrete floor of the building wherever necessary without having direct contact with the reinforcement rods. At the crossing of building walls, floors etc. the earthing conductor will be passed through galvanised conduit sleeves. Both ends of the sleeve will be sealed to prevent the passage of water through the sleeves.

All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters will be connected to the plant ground system.

Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. will be effectively grounded whether specifically shown or not.

Metallic conduits and pipes will not be used as earth continuity conductor. These will be grounded at both ends.

A continuous 50 x 6 mm (minimum size) G.S. flat earthing conductor will run along the cable trays and supporting structure of all cable routes. This earthing conductor will be attached to each section of cable tray/trays through 50 x 6 mm G.S. flats. The earthing conductor will be securely connected to the earth mat at both ends.

Fence within the ground grid will be bonded to the plant ground system at regular interval not exceeding ten (10) metres. Fence gate will be separately grounded with flexible connection to permit movement.

The street lighting poles, junction boxes mounted on the poles, flood light supporting structures etc. will be connected to ground grid at minimum two points.

The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located will be connected to the nearby ground mat by earthing conductor. Electrical continuity will be ensured by bonding the different sections of handrails and metallic stairs.

The railway tracks within plant area will be bonded across fish plates and the rail tracks will be connected to grounding grid at different locations. The rail tracks leaving the plant boundary will be made electrically discontinuous from the rail tracks inside the plant area by providing suitable arrangements at fish plate joints.

The overhead crane rails will be grounded at both ends. In addition all joints will be bonded to provide electrical continuity.

The metallic sheaths, screens and armour of cables will be earthed at both switchgear/MCC/DB and equipment ends.

The flexible earthing connection of jumpering wire will be provided where flexible conduits are connected to rigid conduits to ensure continuity.

3.10 Jointing and Connection

All ground conductor connections below ground level will be done by electric arc welding with low hydrogen content electrode. The contact surfaces will be thoroughly cleaned to provide good electrical continuity.

The bending of the large diameter ground conductor where necessary will be done by gas heating.

The projected portion of riser/pigtail above ground will be coated with two coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.

The connections between the riser/pigtail and earthing conductors (galvanised steel flats) and between the earthing conductors above ground level will be made by electric arc welding.

The portion of galvanised steel flats, which undergoes welding at site, will be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

The earthing connections to equipment grounding pads/terminals and some removable structures will be bolted type with GI bolts and nuts. The contact surfaces will be thoroughly cleaned (to free from scale, paint, enamel, grease, rust) before connection to ensure good electrical contact.

Equipment/structures ground connections will be coated with weather resistant paints/cold galvanising paints after proper checking / testing .

Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. will be effectively grounded.

3.11 Lightning Protection System

The main purposes of lightning protection system are to :

a) Provide protection to structures from lightning strokes.

b) Provide a low resistance-conducting path to lightning discharge.

Lightning protection will be provided as per IS: 2309 for TG area and other tall structures within the battery limit.

3.12 System Design

a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.

b) Horizontal air termination will be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

c) Shielding angle for one vertical air termination will be 45 degrees. For more than one rod, shielding angle between the rods will be taken as 60 Degrees.

d) Down conductors will run along the outer surfaces of the building and will have a test joint about 1500 mm above ground.

e) An earth electrode will be provided at the connection point of the down conductor with the station ground.

f) Galvanised steel rods and flats will be generally used for air termination and connections. All connections will be welded type.

3.13 Air Terminations

The vertical air terminal rods will be installed at the roof of buildings covered under TG package for MCC/Switchgear roomsetc to protect these objects from lightning strokes.

The projected length of the Air termination rod will be as required to protect the object (on which the rod is fixed) from lightning stroke.

The air terminal rod will be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building, the portion embedded inside the concrete will not touch the reinforcement bars and will be duly insulated from them.

All the vertical air terminal rods will be electrically connected together by means of horizontal conductors of size 50 x 6 mm galvanised steel flats.

Horizontal air termination (i.e. G.S. Flat conductor) will be so laid that no part of the rod will be more than nine (9) metres from the nearest roof conductor.

3.14 Shielding Masts

The shielding mast for lightning protection will be installed at the top of steel columns cap plates of the associated building.

The shielding mast will be made of galvanised steel rod and the height of the same will be decided considering the zones to be protected.

Each shielding mast will be connected to grounding grid by a down conductor 50 x 6 mm minimum. Galvanised steel flat run along the building column. In addition all building columns joints will be electrically bonded.

3.15 Down Conductors

Galvanized steel down conductors of suitable size will be connected with air terminal rod/horizontal conductor at the top of roof/structure and other end connected to the nearest 40 mm dia. mild steel rod riser from ground electrode.

Each down conductor will have an independent earth termination. In no case conductors of the lightning protection system will be connected with the conductor of grounding system above ground level.

The connection between each down conductor and rod electrode (by means of 40 mm mild steel rod riser) will be made via test link located at approximately 1500 mm above ground level.

The down conductor will be laid straight and sharp bends will be avoided as far as practicable. These will be cleared on outside of the building wall and column/structure at about 750 mm intervals unless stated otherwise in the drawing.

At all supports for down conductor along the column/wall of the buildings etc. the portion embedded inside the building concrete should not touch the reinforcement bars.

All exposed metallic parts of the buildings will be bonded to the down conductors. Such parts will include ladders, balconies, conduits etc.

The down conductors will be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

3.16 Electrodes (for Lightning Protection)

The electrodes will be 40 mm diameter 3000 mm long mild steel rod. These will be driven into the ground.

All the electrodes will be interconnected by means of one (1) 40 mm dia mild steel rod which will be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn will be connected to main grounding grid.

3.17 Riser (for Lightning Protection)

All risers connected to grounding mat will be 40 mm mild steel rods and will be projected 300 mm above grade level unless stated otherwise.

3.18 Jointing & Connection

All ground conductor connections below ground level will be done by electric are welding with low hydrogen content electrode.

The projected portion of riser above ground will be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.

The joints in the lightning conductors will be kept to a minimum and there will be no joint in the underground portions of conductors.

All the joints will be done by arc welding process overlapping of the conductors at straight joints will not be less than 150 mm. The contact surfaces will be cleaned properly before jointing.

The portion of galvanised steel flats, which undergoes welding at site, will be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

The bolted joint of the test link will be covered with thick coating of bitumen paint after successful testing.

The air terminal rods and shielding mast will be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).

The steel to copper connection will be brazed type.

The lightning protection of inflammable liquid storage tanks wherever required, will be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods will be connected to rod electrodes, which in turn will be connected to station ground mat.

The sizes and materials of earthing conductors to be used in lightning protection system are listed below :

DESCRIPTION	SIZE	MATERIAL
a) Vertical Air Termination	20 mm dia Rod	Galvanised steel
b) Horizontal Conductor	i) 50 x 6 mm Flat ii) 25 x 3 mm Flat	-----do-----

DESCRIPTION	SIZE	MATERIAL
c) Down Conductors	i) 50 x 6 mm Flat ii) 25 x 3 mm Flat	------do-----
d) Ground electrode / riser	40 mm dia Rod	Mild Steel
e) Interconnection with earth mat	40 mm dia Rod	Mild Steel

Note: The above sizes are indicative only. Actual size will be arrived at as per design by the Contractor.

3. CONTROL PANEL

Control Panel

ATTRIBUTES / CHARACTERISTICS / ITEMS/ COMPONENTS, SUB SYSTEM ASSEMBLY	Visual	GA, BOM ,Lay Out of components	Dimensions	Paint Shade/ Thickness/Adhesion	Component Rating/ Make / Type	Wiring	IR & HV	Review of TC for instruments	Accessibility of TBS/ Devices	Illumination	Functional Check for Control Element , Annunciation	Test as per IEC 1131 *	Routine & acceptance Tests as per IS 8623
Control Panel													

Note: 1) Detailed procedure of Burn-in and Elevated Temperature test will be as per Quality Assurance Programme in General Technical Conditions
2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure along with relevant supporting documents.
*Applicable for PLC

4. Motors

Attributes / Characteristics / ITEM/ COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment

Plates for stator frame,end shield, spider etc.									
Shaft									
Magnetic Material									
Rotor Copper/Aluminium									
Stator copper									
SC Ring									
Insulating Material									
Tubes for Cooler									
Sleeve Bearing									
Stator/Rotor, Exciter Coils									
Castings, stator frame,terminal box and bearing housing etc.									
Fabrication & machining of stator, rotor, terminal box									
Wound stator									
Wound Exciter									
Rotor complete									
Exciter, Stator, Rotor, Terminal Box assembly									
Accessories, RTD, BTD,CT, Brushes, Diodes,Space heater, antifriction bearing, cable glands, lugs, gaskets etc.									
Motor (IS 325 / 4722 / 9283)									

5. LT Transformer

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	Core Loss*, Hot Spote	NDT / DP / MPI	Voltage Ratio, Vector Gorup & Polarity	Make / Type / Rating / Model /TC / General Physical Inspection	WPS & PQR	Routine Test as per relevant standard	Measurement of capacitance & tan delta between winding	Routine Test
Enclosure door, H.V. & L.V. Cable Box / Flange Throat													
Copper Conductor													
Insulating Material													

CRGO Lamination & Built Core													
Bushing /Insualtor (IS:2544 / 5621)													
Gasket													
Off-Circuit Tap Cahnger													
Core Coil Assembly													
Marwilling Box													
WTI, Thermister, Terminal Connector													
Welding													
Complete Transformer (IS:11171)													

- Core Loss for first Job

Notes:

1) This is an indicative List of test/checks. The manufacturer is to furnsih a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalisation for all item.
2) All major Bought Out Items will be subject to approval.

9. LT Cables

Attributes / Characteristics / Item / Components / Sub System Assembly	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable	Tensile strength, elongation before & after ageing of insulation & sheath	Thermal Stability of insulation and sheath	Anti termite treatment test	Constructional / requirement as per NTPC	Routine and acceptance test as per Relevant Standard specification	FRLS Test
Aluminum (IS-8130)																
PVC Compound (IS-5831)																
XLPE Compound(IS-7098 Part-I)																
FRLS PVC Compound (IS-5831)/ASTM-D-2843/ASTM-D-2863 IEC-754 Part-I																
Armour wire/ Formed wire (IS-3975)																
Insulated Core																
Laid up core																
PVC Inner sheath																
Armouring																
Outer sheath																
Finish cable (IS-1554 & 7098 Part-1)/ASTM-D-2843/ASTM-D-2863 IEC-754 Part-I Swedish Chimney SEN SS 4241475 for (F3 category)/ Flammability test IEEE-383																
Wooden drum (IS-10418)																

- Not applicable for XLPE insulation

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major bought out Items will be subject to approval.

10. Control Cables

Attributes / Characteristics / Item / Components / Sub System Assembly	Make, Type, Rating, T.C	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Lay length/Sequence	Armour coverage, cross over, looseness, gap between two armour	Sequential marking/surface finish/cable length	Tensile strength, elongation before & after ageing of insulation & sheath	Thermal stability of insulation and sheath	Anti termite treatment test	Constructional feature as per Spec.	Routine & Acceptance test as per relevant standard & specification	FRLS Test
Copper Conductor (IS-8130)															
PVC Compound (IS-5831)															
FRLS PVC Compound IS-5831 ASTM-D-2843 ASTM-D-2863 IEC-754 Part-1															
Armour wire/ Formed wire (IS-3975)															
Insulated Core															
Laid up core															
PVC Inner sheath															
Armouring															
Outer sheath															
Finish cable (IS-1554) ASTM-D-2843 ASTM-D-2863 IEC-754 Part-1 Swedish Chimney: SEN SS 424-1475(F3 category)															
Wooden drum(IS:10418)															

Notes: 1.This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents

2. Make of all major bought out Items will be subject to approval.

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 specification and layout requirement
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	10 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 , Galvanised
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	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	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
11.2	Gear/ pinion material	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	C55Mn75/ En-8/ En-9/ As per IS 3938. (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		
15.1	Material	Cast iron, cast steel or mild steel.	
15.2	Flange / Flangeless	Flanged	
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		
17.1	CT travel	PVC Shrouded bus bar conductor type DSL	
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	
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 (indoor/outdoor)	
18.7	Margin	15% over maximum continuous load demand	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	Snap action, self actuating type	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 Qt y		1 No.
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.
22.0	Power cables	Stranded aluminiu m conductor, c ross link ed polyethylene (XLPE) insulated, extruded black FRLS PVC inner sheathed, armoured a nd ov erall FRLS e xtruded black PVC sheathed cables conforming to IS 7098
23.0	Control cable	1100 V gr ade wit h annealed h igh co nductivity st randed copper c onductor, PVC in sulated, FR LS PVC in ner sheathed, arm oured an d FR LS ex truded b lack P VC o uter sheathed cables conforming to IS : 1554
24.0	Flexible trailing cable	1.1 k V gr ade w ith h ighly flexib le s tranded tinn ed copper conductor, insu lation of E PR (Ethylene-propylene Ru bber) each individual core protected and covered and overall outer cover of p oly-chloroprene rubber cable conforming IS: 9968 (Part-I)-1988.
25.0	Control Voltage	110 V

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PROJECT: 2X500 MW NNTPS (TG)

PACKAGE : ELECTRIC HOIST REV : 0 DATE : 22.12.14

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V Local Starter Panel	Vendor	BHEL	BHEL will provide one number 415 V supply feeders up to DSL for electric hoist
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	BHEL	
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	BHEL	
4	Equipment Earthing	Vendor	BHEL	All equipments metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL / customer.
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 tinned copper heavy duty lugs for power cables. 3 solderless crimping type heavy duty copper lugs for 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 C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

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) Erection and Commissioning spares.
d) Erection & Maintenance tools & tackles.
e) Electrical load requirement for electric hoist
f) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
g) 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
h) 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.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:
Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

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

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

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

4.0 List of enclosures :
a) Specification AC/DC Motors
b) Data sheet of AC/DC Motors.
c) Load data format.

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)

1.0.0 **INTENT OF 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. 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 Qua ntity:

The quantity of various steel wire electric hoist shall be as mentioned in Annexure A.

3.2.0 Type - Electrically operated with trolley.

3.3.0 Capacity / Lift: **As indicated in Annexure - A**

3.4.0 App licable IS	DESCRIPTION
i) IS: 2266	Specification for steel wire ropes for general engineering purposes.
ii) IS: 4029	Guide testing induction motor.
iii) IS: 900	Code of practice for installation and maintenance of induction motor.
iv) IS: 4237	General requirement of switchgear and control gear for voltage motor exceeding 1000 Volts.
v) IS: 694	Copper conductors PVC insulated cables for voltage up to 1000 Volts
vi) IS: 3043	Code of practice for Earthing.
vii) 1S: 1822	Motor starters for Voltages up to 650V.
viii) IS: 2147	Degree of protection provided by enclosures for low voltage switch— gear and control gear.
ix) IS: 1554	PVC insulated (Heavy-duty) electric cables for working voltages and including 1100 volts.
x) IS: 325	Three phase induction motors.
xi) IS: 15660	Point hook with shank.
xii) IS 9968 Part I	Flexible trailing cables

3.5.0 **Material of Construction**

i)	Frame —		M.S.Plate-IS: 2062.
ii)	Wheels	—	Single flanged conform to IS: 3938
iii)	Gearbox	—	MS fabricated IS: 2062
iv)	Hook	--	As per IS: 15560.

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. Any necessary requirement at any stage of inspection deemed necessary by Customer/BHEL shall be carried out without any commercial or technical implication.

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.

6.0.0 Painting Procedure

6.1.0 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.

6.2.0 Machined and bearing surface shall be protected with varnish or thick coat of grease. Also refer "Painting Requirements" in Volume IIB, Section C.

7.0.0 DESPATCH

All the Electric hoists shall be packed to avoid any damage during transits and storage at site.

8.0.0 **POST CONTRACT DRAWINGS AND DOCUMENTS**

The drawings / documents shall be submitted after placement of order as per Clause 3.00 of Section C.

9.0.0 INFORMATION TO BE FURNISHED WITH THE OFFER

As per Annexure II.

10.0.0 COLOUR SCHEME

Color scheme shall be intimated by the purchaser to vendor during the contract execution stage and the same shall be strictly followed.

11.0.0 GENERAL DESIGN FEATURE

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

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

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

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

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

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

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.

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

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

Hoist shall be designed with the following electrical features:

11.1.0 ELECTRICAL MOTOR DESIGN

Motor shall be squirrel cage induction type, and suitable for AC supply of 415V, 3 phase, 50 HZ, 40% CDF with IP—55 degree of protection. Motors shall be class 'F' insulated with temperature rise limited 70^0 C & suitable for 150 starts/hr. Motors shall conform to IS-325 and tested in line with enclosed Quality Plan.

11.2.0 ELECTRICAL POWER

Hoist mounted 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 with SPP features, indicating lamps, cable glands, lugs, terminals, cables etc. housed in totally enclosed IP— 55 degree of panel. Control voltage shall be 110V.

11.3.0 LIMIT SWITCH

Limit switches to prevent over hoisting, over lowering & over travelling shall be provided.

11.4.0 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.

11.5.0 PUSH BUTTON STATION

Pendent push button station shall be provided with minimum 5 nos. of glow type push buttons such as hoisting/lowering, cross traverse forward/reverse and emergency stop (mushroom head type). The contactors are operated by pendent push button station suspended from the hoist for easy operation and suspension is made on steel link chain. Necessary cable glands, lugs, terminals along with connecting cable of 12C—1.5 copper flexible cable shall be provided. Emergency stop push button shall be mushroom head (lockable) type. Pendent push button shall return to off position when released.

11.6.0 EARTHING

All electrical equipment (motor,panel,pendent) shall be provided with proper elements like bolts, washers ,nuts etc. for proper earthing at site.

11.7.0 POWER SUPPLY TO HOIST:

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

ii) Isolator and cable from isolator at 1.5 m operating floor to DSL shall be supplied by the manufacturer.

SPECIFIC ELECTRICAL REQUIREMENT

SL.NO.	PARAMETERS	UNIT	NLC
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, ± 10%
3	FREQUENCY WITH VARIATION	Hz	50 (+) 5% to (-) 3%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 KW & below
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50kA, 1sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F or better and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		0.22 kW & Below
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	As per IS 12615
12	ACCEPTABLE NOISE LEVEL	DB	Noise level for all motors shall be limited to 85dB(A) at 1.5 m (in line with IS 12065)
13	TYPE OF STARTER PROVIDED IN MCC		DOL
14	DOP OF ENCLOSURE		IP-54 for indoor duty
15	SPACE HEATER REQUIREMENT	<30kW	30KW & ABOVE
16	PAINT SHADE		DURING DETAIL ENGINEERING.
17	CRANE DUTY MOTOR AS PER IS3177		S4- Duty with 40% cyclic duration factorshall be considered. Motor operating through VFD shall be suitable for inverteer duty.

	TITLE	SPECIFICATION NO.
BHEL	MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 29/08/2005 SHEET 1 OF 2

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

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

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

VOLUME III

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
																		ANNEXURE-II
DMCW pump/Motor (TG Aux.) 5T		5 kW	U	1	0	D	S	N	I									
Vacuum Pump 3T		3 kW	U	1	0	D	S	N	I									
CONTROL FLUID EQUIPMENT (HWR) HANDLING 3T		3 kW	U	3	0	D	S	N	I									
CW BUTTERFLY VALVE HANDLING 12T		11 kW	U	1	0	D	S	N	I									
MV Swgr room 5T		5 kW	S	1	0	D	S	N	I									
evator machine room 3T		3 kW	U	1	0	D	S	N	I									
ce building elevator machine 3T		3 kW	S	1	0	D	S	N	I									
ANT ROOM 1 (5T)		5 kW	S	2	0	D	S	N	I									

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

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

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

LOAD DATA (ELECTRICAL)	JOB NO.	402	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2 X 500MW NNTPS TPP (TG)	NAME		DATA FILLED UP ON	
	SYSTEM	ELECTRIC HOIST	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

Annexure-VI

VENDOR HAS TO SUBMIT ONLY FOLLOWING DOCUMENTS ALONG WITH THE OFFER, FOR TECHNICAL EVALUATION OF THE BID:-

1) SCHEDULE OF TECHNICAL DEVIATION (IF ANY)
   OR

   'NO DEVIATION CERTIFICATE' – Clearly mentioning that bidder has considered 'No - Deviation' from the technical specification provided by BHEL.

2) SIGNED AND STAMPED COPY OF COMPLIANCE CUM CONFIRMATION CERTIFICATE.
3) Unpriced format, duly mentioned 'Quoted' against each Sl.no. below each column.
4) A copy of the sheet "Electrical Equipment Specification for Electrical Hoists' and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
5) Electrical load requirement in the load data format.

Note1:- Any other standard document/ details furnished by the bidder i.e. Data sheet / GA Drawing/ QAP etc. shall not be taken in to consideration for evaluation.

Note 2:- Bidder to note that if the bidder does not submit the documents mentioned in Sl. No. 1, 2, and 3 along with their offer then their offer is liable to be rejected.

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

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" in section C 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/ CUSTOME R 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 be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification & 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) The EQUIPMENT'S functional guarantees shall st and valid till at least eighteen (18) months from PERFORMANCE G UARANTEE test of equipment as per technical specification or commercial terms and conditions, whichever is later.

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. 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.

Project: 2X500 MW NNTPS, (TG)								
Enquiry No.:								
Package: ELECTRIC WIRE ROPE HOISTS								
Price Format								
S.N.	**Description of equipment / item**	**Total Qty requird**	**Unit ex-works price (duly packed) (Rs.)**	**Total ex-works price (duly packed) (Rs.)**	**Excise duty**	**Central sales tax against form C / VAT (Rs.)**	**Freight charges including service tax @ % (Rs.) if any**	**Total FOR site price Rs.**
1	2	3	4	5	6	7	8	9
1.0	Total lumpsum firm price for design, engineering, manufacturing, inspection and testing at vendor's works, painting, supply/delivery duly packed at FOR Site including freight, for the following Electric Hoists along with Maintenance tools & tackles, commissioning spares, initial fill of lubricants and all other accessories in line with drawings / documents / test procedures approved by BHEL/Customer for the total scope defined as per technical specification PE-TS-402-563-A002 taking into account all clarifications, confirmations and agreements till date.	18 no.s						
	Break-up of 1.0 (1.1 to 1.12)							
1.1	Total lumpsum price of 2 No. Electric Hoist of 5 T cap, 9 m lift, 21 m runway length (straight path) for DMCW PUMPS MOTOR HANDLING (TG) with all accessories including isolating switch, dsl, etc.	2 no.s						
1.2	Total lumpsum price of 2 No. Electric Hoist of 3 T cap, 8 m lift, 21 m runway length (straight path) for VACUUM PUMP MOTOR HANDLING with all accessories including isolating switch, dsl, etc.	2 no.s						
1.3	Total lumpsum price of 6 No. Electric Hoist of 3 T cap, 8 m lift, 10.5m runway length (straight path) for CONTROL FLUID ROOM with all accessories including isolating switch, dsl etc.	6 no.s						
1.4	Total lumpsum price of 2 No. Electric Hoist of 12 T cap, 12 m lift, 10.5m runway length (straight path) for CW BFV (INLET) with all accessories including isolating switch, dsl etc.	2 no.s						
1.5	Total lumpsum price of 1 No. Electric Hoist of 5 T cap, 9 m lift, 5 m runway length (straight path) for MV (HT) SWGR ROOM with all accessories including isolating switch, dsl etc.	1 no.						
1.6	Total lumpsum price of 2 No.s Electric Hoist of 3 T cap, 9 m lift, 7 m runway length (curved path) for TG ELEVATOR MACHINE ROOM with all accessories including isolating switch, dsl etc.	2 no.s						
1.7	Total lumpsum price of 1 No. Electric Hoist of 3 T cap, 9 m lift, 7 m runway length (straight path) for SERVICE BUILDING ELEVATOR MACHINE ROOM with all accessories including isolating switch, dsl etc.	1 no.						
1.8	Total lumpsum price of 2 No. Electric Hoist of 5 T cap, 8 m lift, 30 m runway length (curved path) for AC plant room 1 with all accessories including isolating switch, dsl etc.	2 no.s						
1.9	Total price of eleven (11) sets of Commissioning Spares for 3 T, 5T & 12T capacity Electric Hoists (Break up at ANNEXURE A)	11 sets						
1.10	Total price of one (1) set of Maintenance tools and tackles for 3T, 5T & 12T capacity Electric Hoists (Break up at ANNEXURE B)	1 set						
	Total from sl no. 1.1 to 1.10 (Should match with the price mentioned at 1.0)							
2.0	**Break up prices**							
2.1	**Break up prices of sl no 1.1**							
a)	Total lumpsum price of 2 No. Electric Hoist of 5 T cap, 9 m lift, (straight path) for DMCW PUMPS MOTOR HANDLING (TG) with all accessories	2 no.s						
b)	Total price of isolating switch (located at 1.5m at floor level) and power cable from isolating switch to DSL.	2 lot						
c)	Total price of PVC shrouded type DSL suitable for 21 m travel length in path.	2 lot (each of 21 m						
	m 2.1 a) to c)							
	p prices of sl no 1.2							

Project: 2X500 MW NNTPS, (TG)								
Enquiry No.:								
Package: ELECTRIC WIRE ROPE HOISTS								
Price Format								
S.N.	**Description of equipment / item**	**Total Qty requird**	**Unit ex-works price (duly packed) (Rs.)**	**Total ex-works price (duly packed) (Rs.)**	**Excise duty**	**Central sales tax against form C / VAT (Rs.)**	**Freight charges including service tax @ % (Rs.) if any**	**Total FOR site price Rs.**
1	2	3	4	5	6	7	8	9
a)	Total lumpsum price of 2 No. Electric Hoist of 3 T cap, 8 m lift (straight path) for VACUUM PUMP MOTOR HANDLING with all accessories	2 no.s						
b)	Total price of isolating switch (located at 1.5m at floor level) and power cable from isolating switch to DSL.	2 lot						
c)	Total price of PVC shrouded type DSL suitable for 21 m travel length in straight path.	2 lot (each of 21 m baylength)						
d)	Total from 2.2 a) to c)							
2.3	**Break up prices of sl no 1.3**							
a)	Total lumpsum price of 6 No. Electric Hoist of 3 T cap, 8 m lift, 10.5m runway length (straight path) for CONTROL FLUID ROOM with all accessories	6 no.s						
b)	Total price of isolating switch (located at 1.5m at floor level) and power cable from isolating switch to DSL.	6 lot						
c)	Total price of PVC shrouded type DSL suitable for 10.5 m travel length in straight path.	6 lot (each of 10.5 m baylength)						
d)	Total from 2.3 a) to c)							
2.4	**Break up prices of sl no 1.4**							
a)	Total lumpsum price of 2 No. Electric Hoist of 12 T cap, 12 m lift (straight path) for CW BFV (INLET) with all accessories	2 no.s						
b)	Total price of isolating switch (located at 1.5m at floor level) and power cable from isolating switch to DSL.	2 lot						
c)	Total price of PVC shrouded type DSL suitable for 10.5 m travel length in straight path.	2 lot (each of 10.5 m baylength)						
d)	Total from 2.4 a) to c)							
2.5	**Break up prices of sl no 1.5**							
a)	Total lumpsum price of 1 No. Electric Hoist of 5 T cap, 9 m lift (straight path) for MV (HT) SWGR ROOM with all accessories	1 no.s						
b)	Total price of isolating switch (located at 1.5m at floor level) and power cable from isolating switch to DSL.	1 lot						
c)	Total price of PVC shrouded type DSL suitable for 5 m travel length in straight path.	1 lot (each of 5 m baylength)						
d)	Total from 2.5 a) to c)							
2.6	**Break up prices of sl no 1.6**							
a)	Total lumpsum price of 2 No.s Electric Hoist of 3 T cap, 9 m lift, 7 m runway length (curved path) for TG ELEVATOR MACHINE ROOM with all accessories	2 no.s						
b)	Total price of isolating switch (located at 1.5 m at floor level) and power cable from isolating switch to DSL.	2 lot						
c)	Total price of PVC shrouded type DSL suitable for 7 m travel length in curved path.	2 lot (each of 7 m baylength)						
d)	Total from 2.6 a) to c)							
2.7	**Break up prices of sl no 1.7**							
a)	Total lumpsum price of 1 No. Electric Hoist of 3 T cap, 9 m lift, 7 m runway length (straight path) for SERVICE BUILDING ELEVATOR MACHINE ROOM with all accessories	1 no.						
b)	Total price of isolating switch (located at 1.5 m at floor level) and power [illegible]m isolating switch to DSL.	1 lot						
	[illegible]ce of PVC shrouded type DSL suitable for 7 m travel length in [illegible]path.	1 lot (each of						

Project: 2X500 MW NNTPS, (TG)								
Enquiry No.:								
Package: ELECTRIC WIRE ROPE HOISTS								
Price Format								
S.N.	**Description of equipment / item**	**Total Qty requird**	**Unit ex-works price (duly packed) (Rs.)**	**Total ex-works price (duly packed) (Rs.)**	**Excise duty**	**Central sales tax against form C / VAT (Rs.)**	**Freight charges including service tax @ % (Rs.) if any**	**Total FOR site price Rs.**
1	2	3	4	5	6	7	8	9
d)	Total from 2.7 a) to c)							
2.8	**Break up prices of sl no 1.8**							
a)	Total lumpsum price of 2 No. Electric Hoist of 5 T cap, 8 m lift, 30 m runway length (curved path) for AC plant room 1 with all accessories	2 no.s						
b)	Total price of isolating switch (located at 1.5 m at floor level) and power cable from isolating switch to DSL.	1 lot						
c)	Total price of PVC shrouded type DSL suitable for 30 m travel length in curved path.	1 lot (each of 30 m baylength)						
d)	Total from 2.8 a) to c)							
NOTE								
1	Bidder to note that total price indicated above at 1.00 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.							
2	Any item not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.							
3	Prices mentioned against clause no. 2.1 c), 2.2 c), 2.3 c), 2.4 c), 2.5 c),2.6 c), 2.7 c), 2.8 c) above will be taken for price adjustment due to change in bay length, if any, at actual site condition than mentioned here.							
4	Bidder to note that in their un-price bid, you must indicate as "QUOTED" against unit price & total price column. Price should be indicated in Price Bid only.							
					Signature of bidder with seal			

Project: 2X500 MW NNTPS, (TG)									
Enquiry No.:								**ANNEXURE-A**	
Package: ELECTRIC WIRE ROPE HOISTS									
Price Format									

List of Commisioning spares

Sl.no	Description	Total quantity required	Unit	Unit ex-works price (duly packed) (Rs.)	Total ex-works price (duly packed) (Rs.)	Excise duty	Central sales tax against form C / VAT (Rs.)	Freight charges including service tax @ % (Rs.) if any	Total FOR site price Rs.
1	2	3	4	5	6	7	8	9	10
A	**for 3T capacity electric hoist.**	7	Sets						
I)	Overload Relay								
ii)	Limit Switch								
	Fuse Link								
	for 5T capacity electric hoist.	3	Sets						
	Overload Relay								
ii)	Limit Switch								
iii)	Fuse Link								
C	**for 12T capacity electric hoist.**	1	Sets						
I)	Overload Relay								
ii)	Limit Switch								
iii)	Fuse Link								
	Total for site price for Comm. Spares								
	Date: _____								
	Bidder's / bidder's representative signature					Company Seal			

Project: 2X500 MW NNTPS, (TG)									
Enquiry No.:									**ANNEXURE-B**
Package: ELECTRIC WIRE ROPE HOISTS									
Price Format									

List of Maintenance Tools & Tackles

Sl.no	Description	Total quantity required	Unit	Unit ex-works price (duly packed) (Rs.)	Total ex-works price (duly packed) (Rs.)	Excise duty	Central sales tax against form C / VAT (Rs.)	Freight charges including service tax @ % (Rs.) if any	Total FOR site price Rs.
A.	**COMMON FOR ALL ELECTRIC HOISTS**								
1	Complete set of 6 nos. ring spanners(Indicate sizes)	1	Sets						
2	Complete set of screwdrivers (Min 6 nos , indicate size)	1	Sets						
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.						
	Total FOR site Price of A.								

Note: - 1) The tools shall be supplied in one tool box .

2) Any additional tools and tackles required for maintenance shall be supplied.

Date: _____

Bidder's / bidder's representative signature

Company Seal

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:- 2X500 MW NNTPS (TG)

PACKAGE:- ELECTRIC HOIST

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATIO N/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.