

**TECHNICAL SPECIFICATION
FOR
DOUBLE GIRDER EOT CRANES
FOR TG HALL**

NLC TALABIRA THERMAL POWER PROJECT (NTTPP)

CUSTOMER- NLC INDIA LIMITED NEYVELI, TAMILNADU

SPECIFICATION No. PE-TS-511-501-A501

REV NO. 0



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



**TECHNICAL SPECIFICATION
NLC TALABIRA (3X800 MW PHASE-1)
DOUBLE GIRDER EOT CRANES
FOR TG HALL 150/30T**

PE-TS-511-501-A501

Rev. No. 00

Date : Jun 2026

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PROJECT INFORMATION

SL.NO	DESCRIPTION	DETAILS
1	CUSTOMER	NLC INDIA LIMITED NEYVELI, TAMILNADU
2	CUSTOMER CONSULTANT	DCPL
3	LOCATION	3x800 MW NLC Talabira Thermal Power Project (hereinafter referred to as NTPP),. near Kumbhari & Tareikela villages in Jharsuguda District, Odisha,
4	DATA	
4.1	THE BASIC WIND SPEED “Vb” AT TEN METERS ABOVE THE MEAN GROUND LEVEL.	44 m/sec upto a height of 10 M from ground level
4.2	THE RISK COEFFICIENT “K1”	1.07
4.3	CATEGORY OF TERRAIN	CATEGORY 2
4.4	OTHER FACTORS	IN LINE WITH IS 875
4.5	SEISMIC ZONE	ZONE-III AS PER IS:1893
4.6	DESIGN AMBIENT TEMPERATURE	50 DEG. CELCIUS
5	ELECTRICAL DATA	
5.1	RATED VOLTAGE	415 V
5.2	FREQUENCY	50 Hz
5.3	PERMISSIBLE VARIATIONS FOR	
a.	VOLTAGE	+/-10 %
b.	FREQUENCY	(-)5 to (+)5 %
c.	COMBINED VOLTAGE & FREQUENCY	10 %
5.4	SYSTEM FAULT LEVEL AT RATED VOLTAGE FOR 1 SEC	50 kA
5.5	SHORT TIME RATING FOR TERMINAL BOXES FOR 0.25 SEC	50 kA

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SCOPE

SCOPE OF THIS PACKAGE COVERS THE FOLLOWING:

SL.NO	PARAMETERS	REQUIREMENT
1	Supply Including Design, Engineering, Manufacturing Of	
a)	Main Supply	YES
b)	Commissioning Spares	YES
2	Painting	YES
3	Inspection & Testing	YES
4	Packing	YES
5	Transportation & Delivery To Site	YES
6	Erection & Commissioning	NO
7	Supervision of Erection & Commissioning	YES
8	Performance Guarantee (PG) Test	YES
9	Mandatory Spares	YES
10	Operation & Maintenance Service	NO
11	Operation & Maintenance Spares	YES
12	Storage	NO
13	Healthiness check services & handling over within guarantee period.	YES

EXCLUSIONS

1	Supply feeder and cable from feeder to isolating switch.
2	Steel Gantry girder
3	Dead load for load testing at site
4	Cradle for load/overload testing at site.
5	Unloading storage, transportation from BHEL's yard

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	GENERAL TECHNICAL REQUIREMENT	
1.0	It is not the intent to specify herein all the details of design and manufacturing. Bidder shall ensure that the offered equipment confirms in all respects to high standards of design, engineering and workmanship.	
2.0	The equipment shall comply with all applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed.	
3.0	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.	
4.0	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.	
5.0	Drawing/document submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and training for the same. Bidder to ensure proper internet connectivity at their end.	
6.0	The first revision drawings/ documents submitted by vendor shall be complete in all respects. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place as per the requirement for across the table discussions/ finalizations/ submissions of drawings.	
7.0	In case of any change in codes, standards & regulations between the date of bid opening (as specified elsewhere) and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.	
8.0	Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.	
9.0	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.	
10.0	Bidder shall carry out the type tests as listed in the Quality Plan. OR Bidder shall furnish Type Test Certificate of specified Type Test as per quality plan for applicable equipment which has been carried out within last ten/five years(as applicable and mentioned in respective technical data sheet) from bid opening date These reports should be for the tests conducted on the equipment same (model / type / size / rating) to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In absence of valid Type Test report vendor to conduct the same without any commercial & delivery implication to BHEL.	
11.0	Manufacturing Quality Plan is included for reference in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing. Further all checks and tests indicated in Quality Assurance Requirement as detailed in Customer's specification etc have to be followed.	
12.0	Sub vendor list is attached for reference. Any additional sub - vendors proposed by bidder during contract stage shall be subject to BHEL/ Customer/Customer's Consultant approval.	
13	Document approval by BHEL / Customer shall not absolve the supplier of their contractual obligations of completing the work as per specification requirement without any commercial and delivery impact.	
14	Mandatory Spares	
14.1	One (1) Set is defined as 100% requirement for one crane for the entire cranes of similar size & capacity.	

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14.2	All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then equivalent applicable spare have been offered / shall be supplied without any financial implication.	
14.3	In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder to offer equivalent spares applicable to offered design with quantities generally in line with the approach followed in the above list.	
14.4	Any item which is quoted as "not applicable" in the list and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.	
14.5	Interchangeability and Packings: All spares supplied under this contract shall be strictly inter changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.	
14.6	Identification: Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.	
14.7	Bidder shall not indicate "Not Applicable" against any of the spare (except for those items for which "if applicable" is specified). In case of not applicability, functionally equivalent spare shall be offered.	
15.0	SHOP TEST PROCEDURE FOR GEAR BOX	
15.1	Gear Box Running Test: The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked:	
a	All bolts at the joints remain tight.	
b	All gear mesh lines are getting enough lubrication.	
c	All bearings are getting enough lubrication.	
d	Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour.	
e	Vibration : Maximum limit 125 microns (peak to peak)	
f	Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm.	
g	There shall be no Oil leakage at parting lines, bearing housings or inspection covers.	
15.2	In addition to the above specific points, the following general points shall be ensured:	
a	Inspection pockets are provided as required.	
b	Gear box casings are provided with at least two fit bolts/dowels at the parting line.	
c	Dip sticks with minimum / maximum level markings are provided.	
d	Drain plugs are provided at convenient locations preferably at vertical wall of the housing.	
e	Breathers are provided.	
f	Lifting lugs or eye bolts ar provided as required.	
g	Wherever bearings have splash lubrication, oil retainers are provided.	
h	Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint.	
i	In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided.	
j	Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.	
16	STAGE INSPECTION OF EOT CRANES AT WORKS: Stage inspection of various components of crane shall be guided by the MQP attached with this specification. However, following shall be ensured and read in conjunction with relevant clause of MQP w.r.t. stage inspection:	

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a	For tensile testing of hooks/ forgings, samples shall be drawn from the full cross section of the shank diameter of hooks/ forgings Samples forged to reduced cross section for testing purposes is not acceptable. Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable.	
b	Radiographs shall be inspected to a sensitivity of 2%.	
c	Gear boxes shall be checked at No load for backlash, tooth contact, noise, temperature rise and vibration.	
d	Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification.	
e	For any stage inspection planned outside india like Crane Hook above than 250T (if applicable) ,Arranging inspection including approval of TPI shall be responsibility of Bidder.Necessary cost for same shall be considered by the bidder in their quote/estimates.	
17	Testing at site under supervision of bidder: Completely assembled crane at site shall be check for misalignment of gears, shafts and other items. The test shall be carried out with actual panel, RRC, Master Controller etc. Following minimum tests shall be conducted on the crane at the site	
a	Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.	
b	Load test and Overload test.	
c	Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177	
d	Speed test at rated load for hoisting, CT and LT mechanism.	
e	Brake test.	
f	All Other tests as per IS-3177.	
g	The tests and checks during commissioning at site shall be carried out under supervision of the Bidder as per the Field Quality Plan provided by the Bidder. BHEL shall use the same and get approval for further site work.If during erection and commissioning of the crane/s , protocols are required to be validated and signed by bidder, same shall also deemed to be included under the supervision service.	
18	Services to be provided by the bidder	
a	Packing, forwarding and transportation to site	
19	GENERAL REQUIREMENT FOR SUPERVISION SERVICES FOR UNLOADING, ERECTION & COMMISSIONING, PERFORMANCE GUARANTEE TESTS, HEALTHINESS CHECK AND HANDING OVER WITHIN GUARANTEE PERIOD	
a	Bidder shall be informed at least 10 days in advance for the requirement of visit at site.	
b	Visiting team shall consist of one or two expert of bidder as deemed necessary by them.	
c	Visits during material verification for MRC shall be free of cost by bidder at site.	
d	Visits shall be carried out for supervision of unloading, supervision of erection & commissioning including load testing of crane and lifting beam, Rail & DSL, operation in tandem (if applicable) (including PLC software installation and testing for smooth synchronized running of both EOT cranes).	
e	During erection & commissioning of cranes, if any missing item/s / short supply is noticed and is required, same shall be supplied by bidder on immediate basis without any cost implication to BHEL.	
f	Replacement of all the parts found faulty (due to manufacturing defect, workmanship, material defect or malfunctioning) upto guarantee period of crane/s shall be in bidder's scope.	
g	Bidder has to visit site for Healthiness check & handing over of both the cranes to End-Customer within guarantee period. Requirements of healthiness check & handing over are detailed at Annexure A: REQUIREMENTS FOR HEALTHINESS CHECK in technical specification.	

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SECTION-II

MISCELLANEOUS CRANES

1.00.00 GENERAL INFORMATION

This section covers the Electric Overhead Traveling (EOT) Cranes, Underslung and Semi Gantry Cranes, which will be required for handling various equipment approachable by crane hooks for erection and maintenance purposes. An indicative list of such cranes has been provided in Annexure-I. Apart from these locations, based on layout requirement any additional E.O.T cranes may also be provided to other locations, which warrants based on selection criteria but subject to approval of Owner /Consultant. ~~For Equipment weighing more than 200 Kg but not reachable by the respective EOT cranes, suitable monorail electric/manual hoists to be provided as detailed elsewhere in the specification.~~

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the crane shall conform to the latest editions of the following codes and standards

- | | | |
|---------|--------------|---|
| 2.01.00 | IS : 807 - | Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists. |
| 2.02.00 | IS : 3177 - | Code of Practice for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel Works Cranes. |
| 2.03.00 | IS : 1835 - | Round Steel Wires for Ropes. |
| 2.04.00 | IS : 2266 - | Steel Wire Ropes for General Engineering Purposes. |
| 2.05.00 | IS : 3443 - | Crane Rail Sections. |
| 2.06.00 | IS : 15560 - | Point Hook with Shank up to 160 tones - Specification. |
| 2.07.00 | IS : 5749 - | Forged Ramshorn Hooks. |
| 2.08.00 | IS : 816 - | Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel. |
| 2.09.00 | IS : 1323 - | Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel. |
| 2.10.00 | IS : 9595 - | Recommendations for metal arc welding of carbon & carbon - manganese steel. |

2.11.00 All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended up to date.

2.12.00 ANSI-830.2.0 - Safety codes for overhead and Gantry Cranes.

In case of any contradiction between the above-mentioned codes and standards (item 2.01.00 thru' 2.12.00 above) and this technical specification, the later will prevail. However, nothing in this specification shall be construed to relieve the Bidder of his responsibility to comply with what is mentioned against item 2.11.00 above. However, during detail engineering. If there is any latest amendment to the standard is issued, the same is applicable.

3.00.00 SCOPE OF WORK

3.01.00 Scope of work includes supply of the following:

3.01.01 The required no. of E.O.T, Under slung and Semi Gantry cranes as indicated in Annexure-I having duty and service conditions as specified hereinafter along with all accessories.

3.01.02 Runway rails for entire runway length along with rail clamps, all inserts, insert plates, anchor bolts, nuts, buffers & stops, limit switches etc. as required.

3.01.03 Runway conductors for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc. as specified and as required to complete the installation. Power supply cabling including isolating switch complete along with electrical items, attachments and accessories as required feed power to the runway conductor.

3.01.04 All protective devices, anti-collision limit switches etc. as required for the crane.

3.01.05 All facilities, accessories and attachments for operation of the cranes.

3.01.06 Bridge and trolley current collectors and bridge cross conductors along with all wirings etc. for the crane as specified and as required to complete the scope of work.

3.01.07 Crane components shall be provided with lifting lugs, eye-bolts etc. at suitable locations for handling assembling, lifting and placing into position.

4.00.00 SPECIFIC PERFORMANCE REQUIREMENTS

4.01.00 Capacity (Option – I)

Two numbers of EOT cranes of equal capacity will be provided in the TG hall and these two cranes shall be operating independent with respect to below operational requirements.

~~Each crane shall be capable of lifting at least 110% of the weight of single heaviest component/ equipment (except generator stator), including lifting~~

4.03.00 Lowest Position

4.03.01 The lifting hooks of the turbine hall cranes should reach upto the ground level (0 m). The auxiliary hooks should reach upto the condenser pit level.

4.03.02 In case of all other E.O.T cranes, the lifting hooks should reach upto the floor of its operating area or sump pits or up to the ground level (0 m) as per approved handling arrangement plan.

4.04.00 Horizontal clearance

~~4.04.01 The lifting hooks in vertical position should reach at least upto 5m from the end stopper in case of turbine hall cranes and upto 2.5m in case of all other cranes.~~

~~4.04.02 Either the main or the auxiliary hook in vertical position should reach at least upto 1.5 m from the centre of runway rails in case of turbine hall cranes and upto 1.0 m for all other cranes.~~

4.05.00 If safe and reliable handling necessitates more operating space for the hook approach beyond the values mentioned in the above clause for the E.O.T. cranes, the same shall be provided.

5.00.00 DESIGN & CONSTRUCTION

5.01.00 General

5.01.01 In the design of components on the basis of strength, factor of safety shall not be less than five (5) based on ultimate strength. Impact, fatigue, wear and stress concentration factors shall be taken into account, wherever applicable. Mechanism class shall be as indicated in the Data Specification Sheet.

5.01.02 The crane shall be rigid in construction and all movements shall be smooth and non-jerky.

5.01.03 Drives shall be designed with adequate margin to give best performance and efficiency. Safety arrangements shall be incorporated to prevent damage to motors on account of mechanical overload and electrical faults and to gearing, shafts, etc. due to over-stressing and other detrimental conditions.

5.01.04 All materials shall be of tested quality and shall conform to the specification requirements and standards mentioned and shall be new and first class in all respects.

5.01.05 Castings and forgings shall be of tested quality and shall conform to their respective material specifications and shall be free from flaws and objectionable imperfections, machined true and in a workman like manner.

5.01.06 No wood or other combustible material shall be used unless specifically approved by the Owner/Consultant.

5.01.07 Proposals for repair or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the Owner and his approval must be obtained before any such work is carried out. Drawing showing details and location of such repairs shall be submitted to the Owner.

5.01.08 All fabrication by welding shall be carried out by qualified and certified welders.

5.01.09 Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks.

5.01.10 **Temperature Effects**

Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be kept for stress resulting from these conditions; the co-efficient of expansion for each degree centigrade variation of temperature above and below normal being taken as 0.000012 for mild steel. The maximum range of variation of temperature shall be as given in the Lead Specification. Clause 3.4 of Section 3 of IS: 800-2007 Code of practice for use of structural steel in General Building construction - shall also apply.

5.01.11 Maximum use shall be made of shop fabricated sub-assemblies.

5.01.12 Alternative design to those prescribed in specifications will be considered only if found technically suitable and acceptable to the Owner in the light of requirements and accompanied by substantial reduction in cost.

5.01.13 **Material of Construction**

The material of construction of the major components of the crane shall be as indicated in the Data Specification Sheet. Manufacturers are however free to use alternative material, which are superior for the intended service. But in all cases they are required to obtain prior concurrence of Owner/consultant after furnishing chemical and physical properties of the offered material and any other information that may be asked for by the Owner during detail engineering.

5.01.14 **Load Indication**

The crane bridge shall have permanent inscription in English on each side, readily legible from operating floor, stating manufacturer's name, serial no., the year of manufacture and the safe working load.

5.02.00 **Structural Design Consideration**

5.02.01 **Minimum thickness of metal**

For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8 mm thick.

For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8 mm. The chequered plates for platforms within the cranes, shall be minimum 6 mm thick over plain.

5.02.02 Accessibility for maintenance

All structural parts shall be designed so that they are accessible for periodic cleaning, brushing and painting. All rivets/bolts shall also be accessible for periodic checking.

5.02.03 Ruling dimensions and ratio

a) For compression members, the slenderness ratio shall not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio shall not exceed 180.

b) For girders, the following values of maximum span to depth ratio shall be governing:

Plate girders : Span/depth = 18

Lattice girders : Span/depth = 12

5.02.04 Connections

- a) Unless otherwise specified, only rivetted or welded joints shall be used.
- b) Where welding or riveting is not practicable, turned and fitted bolts shall be used, preferably as per IS-1364 and IS-1367.
- c) Minimum number of rivets or turned and fitted bolts in a connection shall not be less than two.
- d) Black bolts shall not be used in main structures and high tensile bolts shall not be used unless approved by the Owner. Bolts shall preferably be not used in tension.
- e) Where bolts pass through sections having tapered flanges, tapered flats shall be welded to inside of the flanges. Tapered washers shall not be used.
- f) Transverse fillet welds on load carrying members shall be avoided. If side fillets are used in end connections, the length of each side fillet should not be less than the edge distance between the fillets.
- g) Butt welds on structural members under tensile stress shall be checked by Radiographic examination as and when directed by the Owner/Consultant.

- h) Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending.

For splicing tension members, the net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splices is in line with the gravity axis of the member to avoid eccentricity.

5.02.05 Deflections and Camber

- a) The total maximum vertical deflection of the girders produced by the dead load, weight of trolley and the rated load shall not exceed limit of Span/900.
- b) The girders shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

5.03.00 Bridge Girder and End Carriage

5.03.01 The crane shall have single girder or double girder as required unless otherwise specified elsewhere in this specification. A clear head room of minimum 2.5m from the bottom of roof truss to top of crane for TG Hall EOT crane.

5.03.02 The bridge girder shall be box section type or braced I beam type as per standard design of the manufacturer. The exterior surface shall be smooth and as free from projections etc. as possible to minimize dust collection on it.

5.03.03 Single girder cranes shall be provided with suitable truss for supporting the bridge drive machinery and motor.

5.03.04 The crane bridge shall be carried on end trucks of suitable design. Each end truck shall be built up from steel plates welded together to form a closed box section with opening at each end to receive the wheels. Welded to the trucks shall be steel sections to form bearings for the wheel axles and the driving shaft. End trucks shall be provided with rail sweep and bumper. They shall also be provided with suitable jacking pads for maintenance of the wheel and bearings. The location of the jacking pads shall be such that it will not interfere with the maintenance of the wheels and its bearing.

5.03.05 Driving wheels shall be of the double flange and taper tread type and shall be ground to equal diameter in pairs. For under slung cranes hoists block, the wheels shall be single flanged with straight/ taper tread to suit the track beams. The hardness of the wheel shall be slightly higher than the hardness of the runaway rails. Wheels shall be of forged/rolled/ cast steel with minimum hardness of 200 BHN in case of single girder under slung cranes running on rolled steel joist and 300 BHN for EOT cranes and for under slung cranes/ hoists running on wear resistant flats welded to rolled steel joists.

~~Minimum diameter of CT & LT wheels for under slung cranes shall be 150 mm.~~ Wheel axles may be either of the stationary or rotating type as per standard of the manufacturer. If stationary type, they shall be prevented from turning in the truck by means of a key plate fitting into a slot in the end of the axle and if rotating type, wheels shall be keyed to them.

- 5.03.06 Where more than two bridge wheels are used per end truck, the end truck shall be split into two sections, each carrying one bridge independent of other. Two sections of the end truck shall be joined by suitable joining device that will ensure uniform wheel loading. Steel pads shall be welded on the top of end trucks where the girder rests and shall be machined to receive the girder ends.
- 5.03.07 Trolley travel rail ends shall be curved upwards to stop the trolley smoothly and prevent it from leaving the rails in case of over travel at its maximum speed.
- 5.03.08 End trucks shall be equipped with spring/rubber buffers and rail sweep for bridge travel. The rail sweep shall be such that it can push away any object that may fall on the runway. The buffers shall be of substantial design and suitable for engaging the stops at the end of runway.
- 5.03.09 Breathing holes shall be provided in completely enclosed welded box type girders. Drain holes shall be provided in all places where water or oil is likely to collect. Where practicable, means of access shall be provided for inside inspection of completely enclosed box girders.
- 5.03.10 In bridge girder strength calculations, the trolley rails and chequered plates shall not be considered as load carrying members.

5.04.00 **Trolley Frame**

- 5.04.01 The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction.

On bottom of trolley frame, on each side shall be a double spring bumper to engage stops at each end of the bridge.

- 5.04.02 Equalizer sheaves shall be mounted on the trolley frame in such a manner that deflection resulting from the force on the sheaves are not directly transmitted to the hoisting mechanism.
- 5.04.03 Sheaves shall be so arranged on the trolley that rope-revving arrangement resulting there from will ensure a lifting of the load in almost a vertical line with minimum of swing or side-movement.

5.05.00 **Platforms and Ladders**

- 5.05.01 Safe means of access shall be provided to the operator's cab and to every place where any person engaged in the examination or maintenance of the

crane has to work. Adequate handholds and footholds shall be provided as necessary.

5.05.02 One metre high double tier handrail and suitable toe-boards shall be provided along the entire length of platform (on the bridge), which shall not be less than 750 mm wide.

5.05.03 Every platforms shall be provided with steel chequered plate top and be securely fenced with one metre high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely.

5.05.04 In case lattice rivetted construction is offered for the bridge girder, full length chequered plate platform with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items.

5.05.05 Access to operator's cabin from bridge girder platform shall be by staircase having adequate width and proper sloping.

5.06.00 **Operation**

The crane shall be operated either from cabin in the crane bridge or from a pendant control station and radio control station (for TG hall EOT crane only) as specified in Data Specification Sheet.

5.06.01 **Operator's Cabin**

- a) The operator's cabin shall be open type, suitable for indoor service, air conditioned, fire proof construction and complete with light, fan and seat. The cabin shall be located on 'A' row end of the crane bridge, on the opposite side of Down Shop Lead (DSL) and under one of the bridge girders, so that it is offset to one side. The cabin shall be provided with guarding handrails and the floor shall be covered with electric insulating carpet. Clear headroom of 2400 mm shall be ensured within the cabin. Suitable capacity Window /split Air condition and cabin fan shall be provided for operator's cabin
- b) A foot operated type-warning gong shall be provided within the cabin. The cabin shall be of ample size to contain controllers, protective panel, main isolating switch and other accessories required for operating the crane. Adequate capacity and relevant type fire extinguisher shall be provided in the cabin.
- c) Provision shall be there for emergency exit of the Crane Operator at three convenient positions in case of power failure.

5.06.02 **Pendant Station**

- a) The pendant station shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 meter above the operating floor.

- b) With pendant operation, foot operated bridge travel brake and the drum controllers need not be provided.

5.06.03

Radio Remote Control

Radio Remote control (for TG hall EOT cranes only) - In addition to the provision of cabin desk operation and pendant control radio remote operation shall also be provided for TG hall EOT crane alone.

- i) The equipment should have facility to control EOT crane by radio frequency based wireless remote unit. The equipment should be supplied with transmitter unit, receiver unit, encoder unit, decoder unit, interface panel, coupling system, battery unit and any other control gear if required.
- ii) The equipment should be based upon the microprocessor based digital technology with almost nil hard wiring.
- iii) The remote unit should communicate up to the distance of approximately 100 meters.
- iv) The system has to integrate with the control system of crane, which operates at 110 V AC, Single phase.
- v) The remote unit should have transmitter which can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type.
- vi) Frequency allotment for radio remote unit from Govt. of India, Deptt. of Telecommunication or any other agency shall be the responsibility of supplier.
- vii) The transmitter and receiver unit should have its own frequency and address code with each system having its own security code so that one particular set becomes unique and there is no interference from any other remote unit device. A microprocessor should check all security codes. The processor should have its own watchdog circuit. The receiver FM band should be sufficiently narrow to allow only passing of desired frequency and valid command. Any error should shut down the system immediately.
- viii) The remote unit should have safety key to prevent any unauthorized operation. All the crane operations should stop at once the communication breakdown occurs.

- ix) On local unit (receiver side), the system should be provided with one selector switch so that EOT crane can be operated either from Operator cabin or radio remote unit.
- x) The receiver unit along with I/O interface unit should be able to bear the vibrations and shocks encountered in normal usage of EOT crane.
- xi) Spare Remote control unit shall be provided common for both EOT cranes of TG Hall.
- xii) In case tandem operation is envisaged, a suitable selector switch shall be provided in the cabin for selection of Tandem/normal operation.

5.07.00 **Repair Cage**

5.07.01 A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage shall be provided on the trolley to attend these conductors.

5.07.02 Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.

5.07.03 The repair cages shall be adequately sized, guarded for safety and correctly located for the intended service. Suitable access to the cages shall be provided.

5.08.00 **Lifting Hook Block Assembly**

The lifting hook block assembly with locking assembly shall be ramshorn type or approved equal for capacity greater than 40 Tonnes and point hook with shank for capacity below 40 Tonnes and shall be of steel construction. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely on its bearings.

The sheaves of the hook block shall be encased in an oil tight casing permitting generous lubrication of wire ropes and sheaves and also preventing accidental tapping of hands.

All sharp edges on the hooks shall be eliminated to prevent damage to the sling ropes. The hooks shall conform to the requirements of IS: 3177.

5.09.00 **Gearing**

5.09.01 Gears in the speed reducer unit for bridge drive and also all hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The oil shall have additives of approved quality and shall be of approved

viscosity at standard temperature (say 60°C). The housing shall be of sufficient design not to permit a temperature in excess of 90°C for the oil bath and shall be adequately supported and readily removable without disturbing the gear assembly.

5.09.02 Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.

5.09.03 Gears shall have tooth form and modules as recommended in IS-3681 and they shall be adequately designed to stand shock load and vibration and shall not be excessively noisy in operation. The ratings of gears shall be established as per IS : 4460.

5.09.04 Spur and helical gears only shall be used for reduction gearing.

5.09.05 Mounting of the gears shall be such that axial thrust on the bearing is minimum. Centre distance of the connecting shafts shall be as close as possible to the theoretical value. Shafts shall be designed to keep their deflections within permissible limits.

5.10.00 **Bearing**

5.10.01 The type of bearings for various parts shall be as per IS-3177 and standard of manufacturer.

5.10.02 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease.

Arrangement for centralized lubrication of bearings shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished along with the tender.

5.10.03 Suitable drip pans shall be provided as required to collect oil and grease, which may drop, from operating parts. All drip pans shall be accessible for draining and cleaning.

5.10.04 All bearings of the gearing shall be antifriction type. Angular contact ball or taper roller bearings shall be used wherever necessary. The bearings shall correctly locate the shafts while allowing for thermal expansion of the shafts.

Bearings shall be enclosed in suitable housing with proper holes and plugs to prevent any ingress of dirt and to permit easy lubrication of the bearings.

5.11.00 **Guarding**

5.11.01 Guards of an approved design, which will push forward or off the rail track any object placed across it, such as person's foot or arm, shall be attached to each end of the end carriage.

- 5.11.02 Protection guards to live electrical wirings/conductors shall be provided.
- 5.11.03 Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.
- 5.11.04 The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent tapping of a hand between a sheave and the running rope.
- 5.11.05 Effective means of guiding the wire ropes over the sheaves shall be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.
- 5.11.06 All openings in foot walk flooring, for access to bottom chord platform, if any, and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.
- 5.11.07 All electrical panels, resistance boxes shall have suitable rain/ dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before completion of the building roof.
- 5.12.00 **Runway Rails**
- 5.12.01 Crane runway rails with bolts and nuts and complete with shims, anchor bolts, inserts and other fixtures for fixing the rails to crane girders shall be under the scope of supply of the present specification.
- 5.12.02 The length of the rail supplied shall be sufficient to cover the whole of runway length. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.
- 5.12.03 The rail section shall be as per IS: 3443.
- 5.13.00 **Trolley Rail**
- 5.13.01 The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane.
- 5.13.02 The length of the rail supplied shall be adequate for maximum permissible trolley travel. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.
- 5.14.00 **Rail Joints and Fixing**
- 5.14.01 The rails shall be butt jointed by either thermit welding or fusion welding process. The Bidder shall get his proposal for edge-preparation of rails, welding procedure and sequence, approved in advance by the Owner/Consultant.

- 5.14.02 The schemes of securing the rails to the gantry girder/bridge structure with clamps, bolts and nuts, their alignment etc. shall be subject to the approval of the Owner/Consultant.
- 5.15.00 **Tolerances**
- The limits of tolerance as specified in the Data Specification Sheet shall be observed.
- 5.16.00 **Rail End Stops**
- Rail end stops of adequate design shall be provided on both ends of the runway. The end stop location and arrangement shall be such that the unavailable length of runway (for crane operation) on any end is a minimum.
- 5.17.00 **Drive Mechanism**
- 5.17.01 Equal driving effort shall be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.
- 5.17.02 For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per applicable code.
- 5.17.03 For bridge drive, the motor shall be located at mid position of the span. If twin motors are used for drive, motors shall be equidistantly located at each wheel end. Suitable interlock shall be provided to prevent single motor operation at any time.
- 5.17.04 Trolley drive shall be achieved by single motor in which the motor shall drive a common output shaft through proper gearbox and tractive power shall be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.
- 5.17.05 All machineries for the drive unit shall be properly aligned. Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement wherever necessary.
- Wherever components of considerable amount of inertia is directly mounted on the high-speed shaft (e.g. brake drum, couplings, etc.) they shall be balanced statically to minimize vibration.
- 5.17.06 Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 120% of the design load on the hook at the rated speed. For other details the Clause no. 5.19.00 below shall be referred to.
- 5.17.07 Along with the drive mechanisms adequate brakes shall be provided as detailed in Clause no. 5.20.00 below. Selection and design of brakes shall be complete responsibility of the manufacturer. The brakes shall be of accurate rating to stop each motion within a very short distance and in a safe and smooth manner.

5.18.00 Crane Electricals

5.18.01 The crane(s) shall be furnished complete with all electrical equipment, accessories (such as drive motors with VVVF Drives, conductors, insulators, protective & operating devices, cables, current collectors etc.) and cabling/wiring as may be necessary for the efficient and safe operation of the crane.

5.18.02 The crane electricals shall be designed for satisfactory operation from the available power supply as given in the Data Specification Sheet.

5.18.03 If power supply other than that specified is required, the Bidder shall have to make his own arrangement by furnishing all necessary conversion, rectification and transformation equipment and accessories.

5.18.04 Unless otherwise specified, the crane electricals shall be designed for ambient air temperature of 50°C relative humidity of 100% and site elevation less than 1000 metres above mean sea level.

5.18.05 All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.

5.18.06 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance.

5.18.07 The hoist structures, motor frames & metal comes of all electrical equipment on EOT crane/hoist shall be effectively grounded as per Indian Electricity Rules.

5.18.08 Pendant control shall be made up of metal or ABS. If the pendant control is of metal, it shall be earthed.

5.18.09 All equipment offered shall have suitable provisions for termination and connection of Owner's power and control cable inclusive of cable end box, brass compression glands terminal lugs and terminals. Incoming switch-fuse shall be provided at each panel for incoming AC/DC power supplies.

5.19.00 Drive Motors

5.19.01 All crane motors shall be totally enclosed, fan cooled type, having class-F insulation with temperature rise limited to class-B operation in all cases.

5.19.02 Motor enclosures shall conform to the degree of protection IP-55.

5.19.03 Motors shall be Squirrel Cage type, designed for crane duty requirement of frequent starting. Reversing and plugging motors of single girder EOT crane shall also be squirrel cage type. All motors shall be suitable for VVVF operation.

- 5.19.04 Motors shall suit the duty class S4, cyclic duration factor (CDF) 40% and number of cycles per hour 150. Motor pull out torque shall not be less than 2.75 times rated torque.
- 5.19.05 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. Motor shall not stall during operation at voltage dip of 70% for 2 sec.
- 5.19.06 The motor shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage.
- 5.19.07 Deleted.
- 5.19.08 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- 5.19.09 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
- 5.19.10 The starting torque developed by motor at minimum permissible voltage at start i. e. 80% of rated voltage shall be more than the starting torque requirement of driven equipment by margin of at least 10% throughout the range of starting in order to account for higher starting torque required during service due to wear and tear.
- 5.19.11 Motors shall be suitable for both forward and reverse rotation.
- 5.19.12 Motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.
- 5.19.13 The motor shall start smoothly and rapidly and maintain steady operation. The motor characteristic such as speed, starting torque, acceleration time etc. shall be properly coordinated with requirement of driven equipment.
- 5.19.14 Breakaway torque and pullout torque shall be properly coordinated with speed torque characteristic of the driven equipment. The torque speed characteristic of motor super imposed thereon, driven equipment torque speed characteristic at 100%, 90%, 80% and 110% of rated voltage shall be furnished to establish capability to start the motor successfully with load connected.
- 5.19.15 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time.
- 5.19.16 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.19.17 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity.

5.19.18 Each motor rated 30 KW and above shall be provided with space heater, sized to maintain motor internal temperature above dew point when the motor is idle.

5.19.19 In addition to the above requirements, Motors shall meet the specification requirement as detailed in Volume- II F/1

5.20.00 **Brakes**

2 x 100% brake shall be provided for each motion of the crane. Brakes to be as per IS 3177. The Capacity of hoisting motion brakes to be 150% of torque transmitted to the brake drum with full load and that of cross travel and long travel to be 125% of motor rated torque before derating. Selection and design of brakes shall be such as to meet the following requirements:

5.20.01 **Service Brake**

- a) Double-shoe type service brakes shall be provided for each motion of the crane and its hoists. The service brakes shall apply automatically when power supply to the drive motor is cut-off or fails.
- b) Service brakes for main hoist motion of electro-hydraulic thruster type, for all double girder cranes either cabin or pendant or radio remote control operated and electromagnetic disc. type for single girder crane; adequately sized to arrest motion and hold at rest any load up to and including test load at any position of the lift.
- c) Service brakes for main hoist motion of electromagnetic brakes shall be of DC type complete with rectifier equipment to convert the available AC 50Hz supply. The operating solenoids of the EM DC brakes shall reverse the brakes on energization and shall automatically apply all the brakes immediately in the event of stoppage, interruption or failure of electrical power supply. The brakes shall also apply immediately in operating the emergency stop push button of switch irrespective of controller position. The EM DC brakes shall be of spring set shoe type equally effective in both directions of rotation. The springs for the EM brakes shall be of compression type and shall have adequate factor of safety.

5.21.00 **Main Disconnect Switch**

5.21.01 Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs to suit Owner's power supply connection.

5.21.02 The switch shall be provided with "Power On" red indication lamp (LED type) and shall be suitably located so that it can be manually operated from the operating floor level.

5.21.03 Power leads shall run from the main disconnect switch to the runway conductors.

5.22.00 Runway Conductors (Down Shop Leads)

- 5.22.01 The runway conductors shall be four (4) in number for three phase supply and ground.
- 5.22.02 The runway conductors shall be sized so as current density not to exceed 0.42 Amps/sq.mm. Shrouded bus bar with Copper/Aluminium/ MS Angle type DSL may be used.
- 5.22.03 Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.
- 5.22.04 The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.
- 5.22.05 The collector system per conductor shall be top-running type having spring loaded cast iron/carbon metallic shoes to maintain adequate contact pressure.
- 5.22.06 "Power Supply ON" indication shall be suitably provided with LED lamps.

5.23.00 Cross-Conductors on Bridge

Cross conductors on bridge shall be flexible trailing cable system mounted on retracting supports (festoon type).

5.24.00 Power Distribution Equipment

- 5.24.01 From the main collector shoes, wiring shall be extended to two (2) nos., 3-pole, load-break, safety disconnect switches -one at the bridge near the collector and the other in operator's cabin within easy reach.
- 5.24.02 The safety switches shall be capable of cutting-off the supply to all power driven and associated equipment of the crane but not the auxiliary loads such as fans, lights etc.
- 5.24.03 From the safety disconnect switches, wiring shall be extended to a protective panel, containing the following as a minimum:
- One triple pole incoming supply disconnect switch.
 - One triple pole main magnetic contactor with MCB backup, ON-OFF push buttons and RED-GREEN indication lamps (LED type).
 - Motor feeders, each comprising of triple pole MCCB with thermal overload short circuit and over load protection in all three phases of the motor.
 - Outgoing feeders with double-pole MCBs for auxiliary loads such as control supply, lights, fans, etc. with at least one spare feeder.

5.25.00 **Voltage Drop**

5.25.01 All conductors and cables/wires shall be so sized that the voltage drop measured between the main disconnect switch and motor terminals shall not exceed 3% of rated voltage.

5.25.02 The voltage drop shall be computed using the total running current of all crane motors that can operate simultaneously and with rated crane load.

5.26.00 **Safety Interlocks**

5.26.01 MCCB operating handle 'ON' and 'OFF' positions shall be displayed and the operating handle shall be mechanically interlocked with enclosure cover such that the same cannot be opened unless the breaker is in OFF position.

MCCB shall have provision of pad-locking in OFF position.

5.26.02 **Main Contactors**

a) The main contactor shall be electrically interlocked so that it cannot close unless all the motor overload relays are RESET and all controllers are in OFF position for the Lower rated Hoists (up to 2 T) in BOP area.

b) The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

5.27.00 **Emergency Switch**

Mushroom type emergency STOP push buttons to open the main contactor shall be furnished - at least one in operator's cabin and two on bridge platform within easy reach.

5.28.00 **Crane Controls**

The VVVF Drive control shall be used for control of each motion. The VVVF drive shall be provided with step less speed control from 0 to 100%. The VVVF Drive shall be equipped at least with 1024 Pulse in card, droop control for synchronization and crane software. The rating of VVVF shall be decided considering 250% of full load current of respective drive motor.

The VVVF drive shall be suitable for continuous operation. For long travel, motor shall be grouped in two groups and one VVVF drive for each group shall be considered.

5.29.00 **Controllers**

5.29.01 Master controllers for all motions shall be so arranged in the operator's cabin as to provide maximum convenience and view of the operator.

5.29.02 All controllers shall be provided with spring return to OFF position feature. When in OFF position, the controller shall disconnect power supply to the respective motor.

5.29.03 Each controller shall bear suitably engraved inscription of motions controlled in English and of direction of motions by arrows.

5.30.00 **Limit Switches**

5.30.01 The limit switches shall be totally enclosed type IP-55 with properly designed actuators and shall be readily accessible for adjustment and repair.

5.30.02 Each hoist shall be furnished with two (2) limit switches:

- a) A screw type limit switch with self-resetting features, which will act in case of over-hoisting.
- b) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting.

5.30.03 Track type limit switches shall be provided on the bridge and trolley to prevent over-traveling in either direction.

5.31.00 **Panels**

5.31.01 Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity.

5.31.02 The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved nameplates shall be furnished for all panels and also for the equipment and device mounted thereon.

5.31.03 All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals.

5.31.04 Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor.

5.31.05 Incoming switch-fuse shall be provided at each panel for incoming AC/DC power supplies.

5.31.06 Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.

5.32.00 **Moulded Case Circuit Breakers (MCCB) and Miniature Circuit Breakers (MCB)**

5.32.01 MCCBs shall be provided with spring assisted quick make/break manually operated trip free mechanism.

5.32.02 MCCBs shall be provided with adjustable tripping device with inverse time characteristics for overload protection and instantaneous characteristics for short circuit protection. As per requirement, MCCBs shall also be provided with ground fault protection and 1NO contacts for tripping indication / alarm for purchaser use.

5.32.03 MCCBs for motor feeder shall be equipped with instantaneous magnetic adjustable tripping element only.

5.32.04 MCCBs operating handle 'ON' and 'OFF' positions shall be displayed and the operating handle shall be mounted on the door of compartment/module housing MCCBs.

5.32.05 MCCBs shall be provided with minimum 2 NO + 2 NC spare auxiliary contacts

5.32.06 MCBs shall be used in all the AC control circuits and DC control & lighting feeders, as specified. However, control fuses may be used in the ACB feeders for DC circuit.

5.32.07 The MCBs shall be suitable for manual closing and opening and automatic tripping under overload and short circuit conditions. They shall be provided with trip-free mechanism.

5.32.08 The MCBs shall be suitable for housing in the lighting panels and for connection of standard copper / aluminium wires at both the incoming and outgoing ends by copper lugs or bus bars connection on the incoming end.

5.32.09 The terminals of MCB and ON and OFF positions shall be clearly and indelibly marked.

5.32.10 The interrupting current and continuous current rating of the MCCBs shall be as per the requirement.

5.33.00 Not Used

5.34.00 **Contactors** (As applicable)

5.34.01 Contactor shall be suitable for crane duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked.

- 5.34.02 Contactors shall have facility for easy inspection and replacement of parts. Arc chutes shall be provided where necessary.
- 5.34.03 Each contactor shall be provided with three positive acting, ambient temperature compensated, thermal overload relays with adjustable settings to suit the motor current.
- 5.34.04 The relays shall be hand-reset type, suitable for resetting with compartment door closed.
- 5.35.00 **Push Button and Lamp**
- 5.35.01 Push button shall be spring return type, with 2 NO + 2 NC contacts, rated 10A 240V A.C.
- 5.35.02 Indicating lamps shall be LED type with series resistor. Lamps and lens shall be replaceable from front.
- 5.36.00 **Illumination**
- 5.36.01 Crane lighting and space heating systems shall be designed for 240V 1ph 50 Hz supply and receptacle system 240V 1ph 50 Hz supply. Suitable dry type transformers shall be furnished for the purpose, complete with isolation facility and primary/secondary protective devices.
- 5.36.02 The lighting distribution board shall be located in the operator's cabin. Branch circuits for lighting and receptacles shall be individually protected by switch fuse units.
- 5.36.03 LED type lamps with required lux level shall be used for lighting operator's cabin and bridge platform. Adequate number (min 4 nos.) of LED lamp of high bay fitting type shall be provided below bridge for illumination of the working zones.
- 5.36.04 All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
- 5.36.05 24V - 5A - 3 pin industrial socket outlets shall be provided – two (2) in operator's cabin and minimum four (4) on the bridge along the walkway.
- 5.36.06 One (1) portable hand lamp (LED) with plug shall be furnished with adequate length of flexible cable for inspection of crane components.
- 5.36.07 Operator's cabin shall be provided with one (1) electric fan.
- 5.36.08 One (1) heavy-duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator's cabin.
- 5.36.09 Conduit wiring system shall be used for lighting circuits.

5.37.00 Wiring

- 5.37.01 All power, control and auxiliary circuit wiring shall be furnished and installed as per best installation practice. The design shall be such as to maximize shop wiring and minimize field wiring.
- 5.37.02 All wiring shall be done with 1100V grade PVC insulated wire in conduits or by 1100V grade PVC cables with extruded inner sheath.
- 5.37.03 Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 sq.mm in case of copper conductor or 16 sq. mm in case of Aluminium conductor. For selecting the cable rating, motor duty, ambient temperature, grouping, position of cables, voltage drop etc. shall be considered.
- 5.37.04 Conduits shall be heavy gauge, rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints. Conduit entry to pull box or enclosure shall have double locknuts and insulating bushing. No running thread shall be used.
- 5.37.05 Solderless connectors shall be used for all connections. No splices shall be permitted in wire or cable. No taps or connections shall be made in fittings or junction boxes.
- 5.37.06 All wires and cables shall be identified with permanent markers at terminations as per approved wiring diagram.

5.38.00 Grounding

- 5.38.01 The crane rails, structures, motor frames, metal enclosures of all electrical equipment, conduit and tray system shall be effectively grounded in accordance with Indian Electricity Rules.
- 5.38.02 Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.
- 5.38.03 The crane grounding system shall be connected to station ground mat. For this purpose, the Owner will provide ground conductor (50 x 6mm G.S. flat) at two agreed locations.

6.00.00 INSPECTION AND TESTING

- 6.01.00 The Bidder shall submit his Shop and Field Quality Plan as per stipulations of Volume IIA of this specification. The Quality Plan shall indicate all the tests to be carried out in line with the relevant codes. All forgings and castings shall be subjected to ultrasonic examination. DPT/MPI shall be carried out wherever necessary.

- 6.02.00 **Tests at shop**
- 6.02.01 The cranes shall be subject to full load and overload tests as per IS-3177.
- 6.02.02 The crane shall be subject to deflection test as per IS : 3177.
- 6.02.03 Hooks:
- a) All tests including proof load test as per relevant IS/BS/DIN shall be carried out.
- b) MPI/DPT shall be carried out after proof load test
- 6.02.04 Steel Casting:
- DPT on machined surface shall be carried out
- 6.02.05 Girders, End Carriage, Crab, Gear Box and Rope Drum:
- a) The plates of thickness 25mm and above shall be Ultrasonically Tested
- b) NDT requirements on weldments shall be as follows
- Butt Welds In Tension - 100% RT And 100% DPT
 - Butt Welds In Compression - 10% RT And 100% DPT
 - Buttwelds In Rope Drum - 100%RT And 100% DPT
 - Fillet Welds - Random 10% DPT
- 6.02.06 Forging (Wheel, Gears, Pinions, Axle, Hooks & Hook Trunion)
- a) All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to ultrasonic testing.
- b) DPT/MPI SHALL be done after hard facing and machining.
- 6.02.07 Wire rope shall be tested as per relevant standard
- 6.02.08 Reduction gears shall be tested for reduction ratio, backlash & contact pattern. Gear box shall be subjected to no-load run test to check for oil leakage, temperature rise, noise and vibration.
- 6.02.09 The cranes shall be completely assembled at shop for final testing. all tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. as per is-3177 shall be carried out at shop.

- 6.02.10 ~~All electric hoists shall be tested as per IS 3038 and chain pulley blocks shall be tested as per IS 3832.~~
- 6.02.11 ~~Lifting Beam: Lifting beams shall be subjected to suitable test during manufacturing.~~
- 6.02.12 If the hoisting drum offered is of welded construction, the seams shall be fully radiographed.
- 6.02.13 The inspection and testing of butt welded joints shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. But welded joints subject to direct tension shall be 100% radiographed. All 'T' joints shall be covered with spot radiography. Should any of the spots be found defective then radiography to be extended to 100% area.
- 6.02.14 All electrical equipment and components thereof shall be subject to routine tests as per relevant Indian Standards. Type test certificate on any electrical equipment shall be submitted if desired by the Owner. Otherwise, type tests shall have to be performed on the equipment to prove the design.
- 6.02.15 Reports of all shop tests shall be submitted to the Owner/Consulting Engineer for review.
- 6.03.00 **Tests at site**
- 6.03.01 After assembly and erection at site, the crane shall be subject to the following tests:
- a) All tests as per IS-3177, including insulation test and tests for operation.
 - b) Deflection tests as per IS-3177
 - c) Overload tests at 125% of Safe working load (SWL) as per IS-3177
- 6.03.02 Dead loads as required for conducting the tests at site shall have to be arranged by the Bidder at his own cost.

7.00.00 DRAWINGS, DATA AND INFORMATION

- 7.01.00 The following drawings and data are required with the proposal.
- 7.01.01 Crane clearance diagram filling in the various dimensions.
- 7.01.02 General Arrangement Drawings of the E.O.T. crane assembly.
- 7.01.03 Detail drawing showing the features of the components of the crane bridge and trolley.

- 7.01.04 Drawings and data on the crane runway rail, and its method of attachment to runway main girder and general arrangement of runway rail end stops.
- 7.01.05 Schematic drawings of hoisting mechanism cross travel mechanism and long travel mechanism indicating all components as well as rope receiving arrangement and relative positions of equalizer sheaves.
- 7.01.06 A detailed write-up on the crane control system operation. Drawings and data sheets showing the particulars of the controllers, switches, contactors, relays, other control devices and limit switches.
- 7.01.07 A comprehensive write-up and/or Brochure on the details of the manufacturing facilities and the test facilities in the shop of the supplier.
- 7.01.08 Other relevant data and particulars.
- 7.02.00 The following drawings and data shall be submitted for review of Owner/Consulting Engineers by the successful Bidder.
- 7.02.01 Drawings showing general arrangement, clearance requirement, assembly, cross sectional data and materials of construction for:
- E.O.T. Crane Unit
 - Bridge Assembly and Components
 - Bridge End Trucks and Wheel Assembly
 - Trolley
 - Trolley Wheel Assembly
 - Drive and Transmission Unit for Bridge Travel, Trolley Travel, Main Hoist and Auxiliary Hoist.
 - Suspension Unit for Main Hook Block and Auxiliary Hook Block.
 - Main Hook Block
 - Auxiliary Hook Block
- 7.02.02 Drawing showing layout of controllers and protective panels inside the operator's cabin/pendant station.
- 7.02.03 Leaflets on proprietary items such as motors, brakes, gear box, coupling etc.
- 7.02.04 Design calculation of the following:
- Bridge girder, Rope drum, Machinery shafts, Gear box, Motor rating, Brake capacity, Bearing life, Wheel loading etc.
- 7.02.05 Drawings, characteristics curves and other data for each drive motor.
- 7.02.06 Drawings on runway rails and their end stops showing fixtures to fix them on Owner's runway girder.

- 7.02.07 Material test certificates for all items including hooks and wire rope.
- 7.02.08 Reports on various tests at shop and at site.
- 7.02.09 Control and protection scheme along with crane wiring drawing as well as a schematic drawing of control wiring indicating ratings and specifications for motors, contactors, resistors, fuses, etc.
- 7.02.10 As built drawing/electrical control schematic.
- 7.03.00 **Instruction Manual**
- 7.03.01 The Instruction manuals shall present the following basic categories of information in a comprehensive manner prepared for use by operating and/or maintenance personnel:
- i) Instruction for erection
 - ii) Instruction for pre-commissioning checkup, operation, abnormal conditions, maintenance, repair and protection.
 - iii) A detail write up on the crane control system and also on the interlocks provided.
 - iv) Recommended inspection points and periods of inspection.
 - v) Schedule of preventive maintenance.
 - vi) Replaceable part's list with ordering information.
 - vii) Recommendation for type of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.

1.11.05 ANTI-COLLISION DEVICE

Working Principle: The anti-collision system is a safety device to avoid collision of two electric Overhead traveling cranes on the same bay. The system works on the principle of reflection of photoelectric light.

1.	Supply Voltage	:	24V DC
2.	Output Contacts	:	2 CO
3.	Contact Rating		5A @24VDC
4.	Ambient Temp		55 Deg. C
5.	Angle Of Divergence Polarization Filter		10 Degree
6.	Ambient Light		Limit 50000 LUX
7.	Switching Frequency		< 500 HZ
8.	Protection Grade		IP 65
9.	Mounting		Flush Type
10.	Cable gland		SS double compression

**VOLUME: II-F/1****SECTION-II****A.C. & D.C. MOTORS****1.00.00 SCOPE**

- 1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment. Motors for special application like crane, lift, submersible pump etc. individual equipment specifications shall be read in conjunction with this specification.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES & STANDARDS

- 2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC & CBIP Publication except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.
- 2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

Code	Name of standard
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	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
IEC: 60034	Rotating electrical machines.
ISO : 1940-1	Mechanical vibration – Determination of permissible residual unbalance
NEMA, MG-1	Motors and Generators
DIN/IEC/IS	RTD
BS 5308 part II	RTD triad Cable
IS : 15999	Rotating Electrical Machines

**3.00.00 SERVICE CONDITIONS**

- 3.01.00 The motors shall be installed in hot, humid and tropical atmosphere, highly polluted area.
- 3.02.00 Unless otherwise noted, electrical equipment / system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING**4.01.00 A.C. Motors**

- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three / single phase, induction type.
- 4.01.02 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA). However, motors rated 3000KW and above can be Closed air circuit water cooled (CACW). Temperature rise shall be limited to 70 deg.C by resistance method for class F insulation.
- 4.01.03 ~~All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity. However,~~ hoist, crane and elevator motors shall be rated for (S4) duty i.e. 40% cyclic duration factor squirrel cage motor or VFD motors.
- 4.01.04 All LT motors of S1 duty cycle shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. ~~All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively.~~ However, this is not applicable for geared motors (motors completely integrated with driven equipment) which are specifically designed to suit the driven equipment duty.
- 4.01.05 ~~Maximum continuous motor ratings at 50°C shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation, unless stated otherwise in driven equipment specification or in general electrical specification. For S4 duty motors 10% margin on maximum load demand of the driven equipment shall be considered.~~
- 4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.





- 4.01.07 All HV & MV motors shall be provided with vibration pads for mounting vibration detectors.
- 4.02.00 **AC motor for VFD application**
- 4.02.01 Inverter duty motors are designed according to the requirements of IEC 60034 Part-17 & Part-25 or NEMA MG-1, Part-30, Part-31 and have performance characteristics match with the driven equipment and variable speed requirement.
- 4.02.02 Induction motors to be operated in adjustable-speed drive applications should be derated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.
- 4.02.03 Inverter duty motors shall have VPI insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.
- 4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.
- 4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.
- 4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.
- 4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies.
- 4.02.08 The motor shall be provided with insulated bearing on one side.
- 4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VFD requirement.
- 4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.
- 4.03.00 **D.C. Motors**
- 4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.



4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 Running Requirements

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

5.01.02 Low Voltage Running

Motor shall be capable of running satisfactorily at seventy-five (75) percent nominal voltage for five (5) minutes.

5.01.03 Momentary Low Voltage Withstanding

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

5.02.00 Starting Requirements

5.02.01 Motor shall be designed for direct on line starting.

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

5.02.03 All motors shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.

5.02.04 Motor Starting:

Motor shall be suitable for two hot starts (3 starts for conveyor motors) in succession with motor initially at normal running temperature.

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

5.02.06 Break-away Starting Current

Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below: -

- Motors above 160kW upto 1000KW - 600% subject to IS Tolerance of 20%
- Motors (above 1000KW up to 3000KW) - 600% and not subject to any positive tolerance
- Motors above 3000KW - 450% and not subject to any positive tolerance





- LT motors locked rotor current shall be as per IS: 12615
- Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current subject to IS tolerance.
- For D.C. Motors the starting current shall be limited to 2 times full load current.

5.03.00 Stress During Bus Transfer

- 5.03.01 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.03.03 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 5.03.04 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 5.03.05 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 5.03.06 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

5.04.00 Locked Rotor Withstand Time

- 5.04.01 For motors with starting time up to 20secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5secs.

For motors with starting time more than 20secs and up to 45secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5secs.

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

- 5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be needed to shunt out the motor's overload trip device. Speed switches mounted on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity.





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

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

5.05.00 STARTING VOLTAGE REQUIREMENT

5.05.01 All Motors (except Mill Motors)

- a) 80% of rated voltage for Motors up to 4000 kW
- b) 75% of rated voltage for Motors above 4000 kW

5.05.02 For Mill Motors:

- i) 85% of rated voltage for Motors above 1000 kW
- ii) 90% of rated voltage for Motors below 1000 kW

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

6.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction. External FRP canopy shall be provided for all outdoor motors where possibility of accumulation of coal dust and fly ash are present.

6.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.02.00 Direction of Rotation

As needed by driven equipment.

The 3-phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

Direction of rotation in motors shall be as per driven equipment requirement. In case they differ then the spare motors for both the direction of rotation shall be provided for the second.

6.03.00 Cooling

6.03.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).





- 6.03.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.
- 6.04.00 **Winding and Insulation**
- 6.04.01 All insulated winding shall be of copper.
- 6.04.02 HT and MV motors shall have Class F insulation with winding temperature limited to Class B. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.
- 6.04.03 LT motors shall have Class F insulation with temperature limited to Class B.
- 6.04.04 The value of the polarization index for motors above 160kW should not be less than 2 when determined according to IS: 7816.
- 6.04.05 For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages.
- 6.04.06 HT motors shall withstand 1.2/50 micro sec impulse Voltage wave of 4U+5 kV (U=Line voltage in kV). The coil inter-turn insulation shall be as per IEC-60034 – Part 15 followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
- 6.05.00 **Tropical Protection**
- 6.05.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.05.02 All fittings and hardware shall be corrosion resistant.
- 6.06.00 **Bearings**
- 6.06.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.
- 6.06.02 Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- 6.06.03 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.



- 6.06.04 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.06.05 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.06.06 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.
- 6.06.07 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.06.08 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.06.09 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.06.10 HT motors shall have insulated bearings as required to prevent shaft current and resultant bearing damage.
- 6.07.00 **Noise & Vibration**
- 6.07.01 The noise level shall not exceed 85 dB(A) at 1.0 meters from the motor except for BFP motor for which the maximum limit shall be 90dB(A) from operating motor measured in accordance with IS: 12065.
- 6.07.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.
- 6.08.00 **Motor Terminal Box**
- 6.08.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.
- 6.08.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90Deg. unless otherwise approved.
- 6.08.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.
- 6.08.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (11000V/3300V) or XLPE (1100V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part of integral to the motor, for easy termination of the cable. In the case of LT motors, local junction box for terminating main XLPE insulated armoured aluminium cable and copper cable





to terminate at motor terminal box shall also be considered if the main cable number and size warrants the same for easy termination.

- 6.08.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.08.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.08.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.08.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type for below 1000kW motor) with shorting links for star connection.
- 6.08.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.08.10 Separate terminal boxes shall be provided for RTDs and space heaters.
- 6.08.11 The gland plate for single core cable shall be non-magnetic type.
- 6.08.12 ~~Motors rated 1000kW and above shall be provided with neutral current transformers of PS class on each phase in a separate neutral terminal box for differential protection.~~
- 6.08.13 11kV and 3.3kV motors can be offered with either elastomould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastomould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4mm (non magnetic material for 1/C cables) shall be provided in case of cable boxes.

6.09.00 **Grounding**

- 6.09.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.
- 6.09.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90KW	:	50 x 6 mm GS Flat
Motor above 30KW up to 90KW	:	35 x 6 mm GS Flat
Motor above 5KW up to 30KW	:	25 x 3 mm GS Flat
Motor up to 5KW	:	8 SWG GI Wire



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

6.10.00 **Rating Plate**

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

- Temperature rise in Deg.C under rated condition and method of measurement.
- Degree of protection (IP No)
- Bearing identification no. and recommended lubricant
- Location of insulated bearings

7.00.00 **ACCESSORIES**

7.01.00 **General**

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

7.02.00 **Space Heater**

7.02.01 Motor of rating 30KW and above shall be provided with thermostatically controlled space heaters, suitably located for easy removal or replacement. Space heater exceeding 1200W shall be 3 phase.

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

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

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

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

7.04.00 **Indicator/Switch**

- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- 11000V and 3300V motor bearing temperature.
 - Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.
- 7.04.03 Alarm switch contact rating shall be minimum 0.5A at 220V D.C. and 5A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor above and including 1000KW shall be provided with three differential current transformers one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. The CTs shall be of relay accuracy and the CT characteristics shall be compatible with the differential relay. However, the motor vendor to furnish design data (CT specifications), number of CTs, dimensions and mounting arrangements at motor end to Switchgear supplier.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match with the requirements of differential protection relay.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.
- 7.08.00 **Lifting Provisions**
- Motor weighing 25kg or more shall be provided with eyebolt or other adequate provision of lifting.
- 7.09.00 **Dowel Pins**



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

7.10.00 Painting

Painting shall be envisaged as defined in Section – XII of Vol -IIA.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS/IEC. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Type test certificate for H.T & L.T. Motor shall be furnished for approval.

8.03.00 Valid Type test certificates on any equipment shall be furnished for owners review. In case of non-availability of valid test certificate, contractor shall conduct type tests as per IS / IEC without any additional commercial implication to prove the design.

8.04.00 The following type tests shall be performed on a representative sample of 11000V and 3300V motor of each type & rating, even if type test certificates of these tests are submitted by the bidder for purchaser's approval:

1. Measurement of stator resistance (& rotor resistance on slip ring motors)
2. No load running of motor and reading of voltage, current, power input and speed
3. Locked rotor reading of voltage, current, power input and values of torque of motor.
4. Full load reading of voltage, current, power input and slip
5. Temperature rise test.
6. Momentary overload test.
7. Test for vibration severity of motor.
8. Test for noise level of motor.
9. Degree of protection test for the enclosure followed by IR, HV and no load run test.
10. Over speed test.
11. Fault level withstand test for each type of terminal box.
12. Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.
13. Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.





9.00.00 DRAWINGS, DATA & MANUALS

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

9.01.00 Along with the bid

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write up on forced lubrication system, if any
- d) Type test report

9.02.00 After Award of the Contract

- a) Dimensional General Arrangement drawing
- b) Foundation Plan & Loading
- c) Cable end box details
- d) Space requirement for rotor removal
- e) Thermal withstand curves hot & cold
- f) Starting and speed torque characteristics at 80% & 100% voltage
- g) Complete motor data
- h) Erection & Maintenance Manual
- i) Efficiency curves.
- j) List of motors.
- k) Test reports



EPC Bidding Package

NLC India Limited
NLC Talabira Thermal Power Project
3x800 MW,
Jharsuguda, Odisha

VOLUME: II-F/2
SECTION-IV
CABLES



Development Consultants Pvt. Ltd.

Vol. II-F2/Section-IV
Cables



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**VOLUME: II-F/2****SECTION-IV****CABLES****1.00.00 SCOPE OF SUPPLY**

1.01.00 Power and control cables shall cover the entire requirement of EPC Package. The cables shall be furnished in accordance with this specification and Annexure.

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

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

- | | | |
|---------------------------------|---|-----------------------------------|
| a) H.V. Power cables | : | Annexure – IA & IB |
| b) L.V. Power Cables | : | Annexure – II |
| c) Control Cables | : | Annexure – III |
| d) LT FS Power & Control Cable | : | Annexure – IV |
| e) Flexible Trailing Cables | : | Annexure – V |
| f) Standard Cable Sizes | : | Annexure – VI |

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

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

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

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



**3.00.00 DESIGN CRITERIA**

- 3.01.00 The cables shall be used for connection of power and control circuits of the auxiliary electrical systems. Number of different sizes selected shall be kept to a minimum for optimization.
- 3.02.00 Cables shall be generally laid on ladder/perforated type trays on pipe cum cable trestle or on only cable trestle or drawn through rigid galvanized steel conduits.
- Other outdoor cable routing shall generally be on ladder type cable trays. Generally, cables shall not be directly buried in the ground except for some exceptional cases subject approval of Owner.
- 3.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and / or this specification which one is more stringent.
- 3.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.05.00 Armouring shall be galvanized steel round wire or galvanized steel Flat/strip for multicore cables and aluminium for single core cable.
- 3.06.00 The inner & outer sheath shall have flame retardant low smoke low halogen (FRLSH) characteristics and shall meet the requirements of additional tests specified for this purpose.
- 3.07.00 Core identification for multicore cable shall be provided by color coding.
- 3.08.00 For 3.3KV and above rating cables shall be dry cured in pressurized nitrogen atmosphere.
- 3.09.00 Maximum continuous operating temperature shall be 90deg C under normal operation and 250deg C under short circuit condition for XLPE cables. Maximum continuous operating temperature shall be 70deg C under normal operation and 160deg C under short circuit condition for PVC cables.
- 3.10.00 Power cables shall be chosen taking into account the factors mentioned in section-I.
- 3.11.00 The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion/process.

4.00.00 SPECIFIC REQUIREMENTS**4.01.00 General Description**

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



**4.02.00 Drum Length and Tolerance**

The cables shall be supplied in non-returnable packing steel drum for 3.3kV, 11kV & 33 kV power cables, wooden drums for 1.1kV power and control cables.

The standard drum length for HT, LT power, Control cables shall be 500/750/1000 meters. Allowable tolerance on individual drum length is (+) 5%.

Any cable drum length, other than mentioned above, may be allowed on exceptional case, based on requirement, subject to Owner's approval.

4. 03.00 Packing

4. 03.01 Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4. 03.02 Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat shrinkable cable cap shall be used for this purpose.

4. 03.03 A label shall be securely attached to each end of the reel indicating the Purchase's order number, length, type, voltage grade, conductor size and number of cores of the cable. A tag containing the same information shall be attached to the leadings end of the cable inside. An arrow and necessary instructions shall 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. 03.04 The cable drums should carry the following details in printed form:

- a) NLCIL NTPP Stage -1 & Manufacturer's name or trademark
- b) Type of cable & voltage grade
- c) Year of manufacture
- d) Type of insulation e.g. XLPE
- e) No. of core and size of cables
- f) Cable code
- g) Length of cable on drum
- h) No. of length on drum, if more than one





- i) Direction of rotation, by arrow
- j) Approx. gross mass.
- k) Reference Standard
- l) ISI Mark.

4. 04.00 **Joints and Terminations**

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

Cable Joints are not allowed for Power cables and Control cables.

However, for power cable, cable joints are allowed, if the route length exceeds the maximum transportable drum length for particular cable size.

4.05.00 **Selection Criteria**

4. 05.01 In cable sizing the following are to be taken into consideration.

- a) Short circuit current and duration
- b) Continuous current.
- c) Installation conditions.
- d) Voltage drop under normal running and starting condition.
- e) Grouping factor and laying method.

4. 05.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4. 05.03 The standard cable sizes, capacities, derating factors, etc. as given in IS / IEC shall be generally followed.

4. 05.04 For breaker protected circuits minimum size shall be determined by short circuit rating. Cables shall withstand the system short circuit current for duration of 0.2 secs in case outgoing motor and transformer feeders and 1 sec for Incomers and Tie feeders.





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

For VFD fed drives, cables shall be selected to as per the recommendations of VFD OEM.

4.05.05 The conductor sizes shall be so selected that the voltage drop shall not exceed 3% while carrying the full load current.

4.05.06 For practical purposes, the minimum size for power cable shall be chosen as below:

- Aluminium : 16 Sq. mm.
- Copper : 2.5 Sq. mm.

All drives of small rating where terminations with 16sqmm cables are not feasible, shall have copper cable.

4.05.07 All control cables shall be 1.5 sq. mm copper cable minimum. CT & PT circuits shall be wired with 2.5 sq.mm copper conductor cables as minimum. However in case of CT circuits with 5A secondary current and longer length cables 4 sq.mm cables shall be selected as a minimum.

4.05.08 Multicore Control Cables shall generally have at least 20% spare cores.

Conductors required**Cables**

1 or 2	1-3/C
3 or 4	1-5/C
5	1-7/C
6 or 7	1-9/C
8, 9 or 10	1-12/C
11 or 12 C	1-16/C
13 or 14 C	1-19/C
Above 14	Two or more of above cables

4. 05.09 Separate cables for each type of following services / functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.





e) C.T. Cables.

f) V.T. Cables.

4. 06.00 **Cable Identification**

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

- a) NLCIL Talabira TPP -Stage-1& Manufacturer's name or trademark
- b) Voltage grade
- c) Year of manufacture
- d) Type of insulation e.g. XLPE/PVC
- e) No. of core and size of cables.
- f) Type of improved fire performance, e.g. FRLSH
- g) Owner's identification mark
- h) IS/IEC number.
- i) Sequential length marking at an interval of 1m throughout the length of the cable.

4. 07.00 Selected sizes of power and control cables are given in Annexure-F.

5.00.00 TESTS

5.01.00 Shop Tests

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

5.01.01 Routine tests on each drum of cables.

The following minimum tests shall be carried out as routine tests on each and every drum length of cable, as per IS 7098 (Part 2) / 1985, in addition to other tests.

- a) High Voltage Test
- b) Conductor Resistance Test.
- c) Partial discharge test (for screened cables) – on full drum length.

5.01.02 **Acceptance Test**



The following test shall be carried out as Acceptance Test in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis in each lot for the Acceptance Tests which shall be carried out at manufacturer's/supplier's cost:-

- a) High Voltage Test
- b) Annealing Test
- c) Conductor Resistance Test
- d) Tensile / wrapping test.
- e) Partial discharge test (In screened cables).
- f) Insulation Resistance/Volume resistivity test
- g) Measurement of thickness of insulation and sheath and other dimensions
- h) Tensile strength & elongation at break for insulation & sheath.
- i) Hot set test on XLPE insulation
- j) Flammability test as per Swedish standard SS:424-15-75 Class-F-3 (Swedish Chimney test)/IS:10810
- k) Acid gas generation test as per IEC-754-1/IS: 10810
- l) Smoke density test as per ASTM-D-2843/1977/IS:10810
- m) Oxygen index test as per ASTM-D 2863/1977/IS:10810
- n) Temp. index test as per ASTM-2863/77/IS:10810
- o) Test for Rodent and termite repulsion property

Flammability test on finished cable Sample as per following method

- | | |
|-------------------------|----------------------------|
| a) Fire Survival Test | - IEC-331 |
| b) Swedish Chimney Test | - SS-424-14-75
Class-F3 |

5.01.03 Type tests on each type of cable, size and batch inclusive of measurement of armour D.C. resistance of power cables in compliance with relevant IS.

5.02.00 **Additional Tests**

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Type FRLSH):

5.02.01 **Oxygen index test**

The Oxygen index shall not be less than 29 at room temperature. This test shall be carried out as per American National Std. ASTM-D-2863/77.

For determination of the temperature index, the oxygen index test shall be carried out at different temperature up to 250°C. However, the test shall be carried out by extra-polation method beyond temperature at which the material of sheath may start deformation. The minimum temperature index (i.e. the temperature at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.

5.02.02 **Temperature Index Test**

The measured value of temperature index shall be not less than 250°C.

5.02.03 **Flame Retardance test on single cable and on bunched cables**

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.

Swedish Std.SS:424-14-75 Class-F3. This test known as Swedish Chimney test is compulsory.

IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by purchaser.

IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

5.02.04 **Halogen acid gas evolution test**

This test shall be carried out as per IEC Std. 754-1. The level of HCL evolved shall not exceed 20 per cent by weight

5.02.05 **Smoke density test**

This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. The cables shall meet the requirements of light transmission of minimum 40% after the test.

5.02.06 **Test for rodent & termite repulsion property**

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

5.03.00 **Test Witness & Test Certificates**



- 5.03.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.
- 5.03.02 Test reports shall be completed with all details and shall also contain IS specified limit values, wherever applicable, to facilitate review.
- 5.03.03 The cables shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

6.00.00 DRAWINGS, DATA & MANUALS

6.01.00 To be furnished after award of contract

- a) Manufacturer's catalogues giving cable construction details and characteristics.
- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test report on all specified cables.
- e) Proposal Data as per Annexure.
- f) Confirmed cable data
- g) QAP & Test reports

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

- 6.03.01 Guaranteed Technical Particulars.
- 6.03.02 Quality assurance plan
- 6.03.03 Shop Test reports
- 6.03.04 Instruction manuals
- 6.03.05 The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.
- 6.04.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

**ANNEXURE-II****L.V. POWER CABLES 1100 V GRADE**

1100 V grade, 90°C continuous rating under normal condition and 250°C short time rating under short circuit condition XLPE insulated FRLSH sheathed heavy duty, power cable conforming to following requirement and in line with IS 7098, IS 8130, IS 5831 and IS 3975.

DESCRIPTION	SPECIFICATON
Conductor	Stranded and compacted plain aluminium of grade H2 and Class 2 stranded, high conductivity annealed plain copper generally conforming to IS: 8130.
Insulation	Extruded Cross-Linked polyethylene (XLPE)
Core Identification	By color coding
Inner Sheath	Extruded FRLSH PVC compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
Armour	Galvanised single round 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 FRLSH PVC compound conforming to type ST2 of IS: 5831
Oxygen Index	Minimum 29%
Drum	Conforming to IS-10418 (Wooden drum)



ANNEXURE-III

CONTROL CABLES

1100 V grade 70°C continuous rating under normal condition and 160°C short time rating under short circuit condition PVC insulated FRLSH sheathed control cable conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

DESCRIPTION	SPECIFICATON
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
Core Identification	By color coding and numbering at interval of 100mm or less
Inner sheath	Extruded FRLSH PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST1
Armour	For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel wire/strip armour shall be provided.
Overall sheath	Extruded FRLSH PVC compound conforming to type ST1 of IS: 5831
Oxygen Index	Minimum 29%
Drum	Conforming to IS: 10418 (Wooden drum)



ANNEXURE-IV

1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES

1100V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core / single layer of round galvanized steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 950 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES

1100V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core / single layer of round galvanized steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 950 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.



ANNEXURE-V

FLEXIBLE TRAILING CABLES

1100V Grade

11kV/3.3kV Unearthed Grade flexible trailing cable, annealed tinned copper conductor, Class – 5 of IS – 8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS: 99610. Alternatively PCP sheathing may be acceptable.

ANNEXURE-VI

STANDARD CABLE SIZES (Only for Reference)

Sl. No.	Cable Size	Conductor	Insulation
1.0	HT Cables		
1.1	1 core 70 Sq. mm	AL	XLPE (FRLSH)
1.2	3 core 150 Sq. mm	AL	XLPE (FRLSH)
1.3	3 core 185 Sq. mm	AL	XLPE (FRLSH)
1.4	3 Core 240 Sq. mm	AL	XLPE (FRLSH)
1.5	3 core 300 Sq. mm	AL	XLPE (FRLSH)
1.6	1 core 630 Sq. mm	AL	XLPE (FRLSH)
2.0	LT Power Cables		
2.1	2 core 2.5 Sq. mm.	CU	XLPE (FRLSH)
2.2	3 core 2.5 Sq. mm.	CU	XLPE (FRLSH)
2.3	4 core 4 Sq. mm.	CU	XLPE (FRLSH)
2.4	2 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.5	3 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.6	4 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.7	3 core 25 Sq. mm.	AL	XLPE (FRLSH)
2.8	2 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.9	3 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.10	4 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.11	3 core 50 Sq. mm.	AL	XLPE (FRLSH)
2.12	3 core 70 Sq. mm.	AL	XLPE (FRLSH)
2.13	4 core 70 Sq. mm.	AL	XLPE (FRLSH)
2.14	3 core 95 Sq. mm.	AL	XLPE (FRLSH)
2.15	3½ core 95 Sq. mm.	AL	XLPE (FRLSH)
2.16	3 core 150 Sq. mm.	AL	XLPE (FRLSH)
2.17	3 core 185 Sq. mm.	AL	XLPE (FRLSH)
2.18	3½ core 185 Sq. mm.	AL	XLPE (FRLSH)
2.19	3 core 240 Sq. mm.	AL	XLPE (FRLSH)
2.20	3½ core 240 Sq. mm.	AL	XLPE (FRLSH)

Sl. No.	Cable Size	Conductor	Insulation
2.21	3 core 300 Sq. mm.	AL	XLPE (FRLSH)
2.22	3½ core 300 Sq. mm.	AL	XLPE (FRLSH)
2.23	1 core 630 Sq. mm.	AL	XLPE (FRLSH)
2.24	1 core 400 Sq. mm.	AL	XLPE (FRLSH)
2.25	3 core 400 Sq. mm.	AL	XLPE (FRLSH)
2.26	3½ core 400 Sq. mm.	AL	XLPE (FRLSH)
3.0	Control Cable		
3.1	2 core 1.5 Sq. mm.	CU	PVC (FRLSH)
3.2	3 core 1.5 Sq. mm.	CU	PVC (FRLSH)
3.3	5 core 1.5 Sq. mm.	CU	PVC (FRLSH)
3.4	7 core 1.5 Sq. mm.	CU	PVC (FRLSH)
3.5	12 core 1.5 Sq. mm.	CU	PVC (FRLSH)
4.6	16 core 1.5 Sq. mm.	CU	PVC (FRLSH)
3.7	19 core 1.5 Sq. mm.	CU	PVC (FRLSH)
3.8	2 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.9	3 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.10	5 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.11	7 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.12	12 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.13	16 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.14	19 core 2.5 Sq. mm.	CU	PVC (FRLSH)
4.0	Cables For Electronic Equipment Grounding		
4.1	1 core 35 Sq. mm.	CU	HR-PVC/XLPE (FRLSH)
4.2	1 core 150 Sq. mm.	CU	HR-PVC/XLPE (FRLSH)

Note: In case of multiple run feeders, cable size of each run shall be same.



EPC Bidding Package

NLC India Limited
NLC Talabira Thermal Power Project
3x800 MW,
Jharsuguda, Odisha

VOLUME: II-F/2
SECTION-XI
VARIABLE FREQUENCY DRIVE



Development Consultants Pvt. Ltd.

Vol. II-F2/Section-XI
Variable Frequency Drive



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**VOLUME: II-F/2****SECTION-XI****VARIABLE FREQUENCY DRIVE****1.00.00 SPECIFIC REQUIREMENTS**

Variable frequency drives shall be provided as per technological requirement. The following paragraphs define the requirements of variable speed drives.

- 1.01.01 Wherever LV VFD drives are provided , One spare VFD panel similar in all respect to other VFD panels to be provided and erected for each unit in case of coal feeders. In case of major failure in any of the VFD panels, Power & Control Cables shall be removed from the defective VFD panel and connected to the spare VFD panel.

Wherever MV VFD drives provided for HV / MV motors, the same shall be with bypass arrangement to start and run the motor during VFD outage.

2.00.00 TECHNICAL PARTICULARS

The drive System shall be designed to operate at Specified site condition, 6 pulse for Drives rated up to 90kW, 12-pulse (having two channels, each channel with six pulse design)/Active front end for drives above 90kW up to 160kW and Minimum 24 pulse design for drives rated above 160kW. The VFD and accessories shall comply with the particulars as per the technical requirements specified in Annexure-A.

3.00.00 CODES & STANDARDS

- 3.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC, ANSI & NEMA Standards except when otherwise stated herein or in the driven equipment specification.
- 3.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.
- 3.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up-to-date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

4.00.00 PERFORMANCE REQUIREMENTS

- 4.01.00 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/wear/ noise.





- 4.02.00 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the drive motor, with input supply variation of $\pm 10\%$ and frequency variation of $\pm 5\%$. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit.
- 4.03.00 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment
- i) Variable torque changing as a function of speed i.e. speed squared
 - ii) Constant torque over a specific speed range
 - iii) Constant power over a specific speed range where the torque decreases when speed increases
- 4.04.00 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field be separately programmable from 0.1 to 20 seconds.
- 4.05.00 Each channel and motor rating shall be rated to meet driven equipment requirements. The system shall be designed for linear continuous speed control from required range of driven equipment rated speed and shall be of a modern proven design, the speed variation shall be with the range 10 – 100% with a speed accuracy of $\pm 0.5\%$
- 4.06.00 The Total Harmonic Distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800-4. VFD output shall be pure sine wave with harmonics distortion in output voltage and Current less than 3%.
- 4.07.00 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current & voltage distortion as per recommendations in the latest edition of IEEE-519.
- 4.08.00 The overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 115% of rated current for one minute for variable torque application at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If the load demand exceeds the current limit for more than one (1) minute, the drive shall shut down to prevent overheating of the motor and damage to the drive.
- 4.09.00 During operation, the system shall be capable of developing sufficient torque under all load condition to respond to a 20% alteration in speed set point within a time limit up to 60 seconds
- 4.10.00 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 second.



- 4.11.00 The drive shall trip in case the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 second.
- 4.12.00 Maximum noise level from the drive at 1meter distance, under rated load with all normal cooling fans operating shall not exceed 85dBA.
- 4.13.00 Variable frequency drive shall be arranged so that it can be operated in a circuit mode, disconnected from the motor for startup adjustment and troubleshooting/ maintenance.
- 4.14.00 Voltage at motor neutral terminal shall be at ground potential for the total operating condition.
- 4.15.00 The drive system shall ensure following
- a) Harmful VFD induced harmonics which can create motor heating are eliminated.
 - b) VFD induced torque pulsation are limited to maximum 1% (even at low speed) so there is minimal stress to the equipment
 - c) Motor is protected from dv/dt stresses.
 - d) No appreciable increase in motor audible noise
- 4.16.00 The vendor should demonstrate the system efficiency with drive loaded to motor rated Power. System Efficiency (including input transformer/Drive System and sine filter if included) should be greater than 96.5% for 50% to 100% loading.
- 4.17.00 The IGBT drive shall be capable of detecting output ground fault of 10mA to ensure personal safety. The manufacturer shall provide a valid type test to show that protection and detection works as described.
- 4.18.00 The vendor to guarantee the MTTR and MTBF.
- 4.19.00 Electrical performance of the system shall comply to IEEE, IEC and equivalent international standard.
- 5.00.00 CONTROL REQUIREMENT**
- 5.01.00 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.
- 5.02.00 Short time voltage dip up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.
- 5.03.00 The system shall also be equipped with a facility which will restart the system in case of voltage dip over 20% or power interrupter for less than 2 seconds, with recovery of the voltage to its normal value and ride through operation feature



for 0.3 seconds (for normal motor)/2 seconds (for high inertia motor). The drive shall have the facility to block this feature, if required by operator.

Upon restart the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds. If the input supply falls below 90% for the rated, drive shall still continue its operation with reduced output power.

- 5.04.00 The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.
- 5.05.00 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10V reference input signal. Unless otherwise specified, upon complete loss of the users speed reference signal, the drive shall automatically run at constant speed as at 8-100% of the last speed reference available prior to the loss of signal.
- 5.06.00 It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/manual selection shall be from VFD panel unless otherwise specified.
- With the selector switch in “manual” mode, the operator shall be able to set the speed through keypad, mounted on front of the drive panel or from speed increase/decrease push buttons from the field. Motor operated potentiometer shall be provided as a speed set point device.
 - With selector switch in “auto” mode, speed of the motor shall be controlled from a 4-20mA signal, from owner’s PLC/DDCMIS system. Necessary equipment like protocol converter as required for interfacing with PLC/DDCMIS shall also be provided in the drive panel.
- 5.07.00 The required provision for the interface with remote PLC/DDCMIS located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification).
- 5.08.00 Drive system shall have provision for interface with upper level automation such as substation monitoring system or electrical control system.
- 5.09.00 The closed loop control feedback for the drive system having output transformer shall be tapped from the secondary side of the output transformer.
- 6.00.00 PANEL CONSTRUCTION**
- 6.01.00 The panel shall include suitable semi conducting power devices (line commuted thyristors / Diodes / IGBT). Modules with protective devices, reactors (if required), filters (if required), control circuit, control accessories, indication and annunciation, etc., the construction of the panel shall provide effective protection against electromagnetic emissions and shall meet design requirement of integrated standards



- 6.02.00 Upstream breaker “ON/OFF/TRIP” indications and remote breaker closing and trip push button shall be provided on the front door.
- 6.03.00 Safety Interlock shall be provided so that power cabinet can’t be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.
- 6.04.00 Duplicate control supply with automatic changeover shall be provided. Protection shall be provided against AC/DC transients, voltage surge etc. of power and control device.
- 6.05.00 The drive shall be housed in sheet steel panels fabricated with 2mm thick cold rolled sheet steel. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-42. The maximum operating height shall be 1800mm approximately.
- 6.06.00 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10mm² and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate.
- 6.07.00 Bus bars shall be of electrolytic copper, color coded separately for AC and DC system. All the live parts shall be sleeved/ shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.
- 6.08.00 All the switches, component and accessories which are essential for normal and emergency operation shall be mounted on the door and shall be operable externally. All the analog instruments, where provided, shall be switchboard type, back connected; 72x72mm. Scale shall have red mark indicating maximum permissible operating rating.
- 6.09.00 Each panel shall be provided with illuminating lamp/11W LED with switch and MCB. 6/16A, 240V power socket with switch and MCB shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.
- 6.10.00 Copper earth bus of min. 50x6 mm size shall be provided in the panel with provision for connection to plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system as required shall be provided.
- 6.11.00 All the metal parts shall be treated so as to ensure efficient anti-corrosive protection. Hard wares shall be zinc passivated or electrogalvanized. Panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scale and rust etc. External surface shall be painted RAL – 5015 with two coats of synthetic enamel paint.



- 6.12.00 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.
- 6.13.00 All the control wiring shall be enclosed in plastic/metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, copper conductor wire. 1.5 mm² size wire shall normally be used provided the control-MCB rating is 10 Amps or less and 2.5 mm² size for control MCB-rating above 16A for electrical circuits and 0.7 mm² for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminal shall be provided.
- 6.14.00 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipment and power electronic equipment shall be used.
- 6.15.00 All low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.
- 6.16.00 DC link capacitor and pre charging and discharging circuit shall be preferably mounted in the rear of the panel.
- 6.17.00 Suitable removable type hooks shall be provided for lifting the panel.
- 6.18.00 Perspex type transparent insulating material shall be used for covering live compartments.
- 6.19.00 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.
- 6.20.00 All the equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively.
- 7.00.00 COOLING**
- 7.01.00 The drive panel shall be naturally cooled type as per manufacturer's standards. If unavoidable, forced type cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel-cooling fan shall be considered. Vendor shall ensure that the panel dimensions and the flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+1) shall be provided.
- 7.02.00 Necessary starters shall be provided within the VFD panels for the ventilation fans, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shut down such that safety interlocks such as start

permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., shall be incorporated in the overall sequence logic.

7.03.00 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space etc. shall be included and mounted in easy accessible location.

8.00.00 EQUIPMENT/COMPONENT SPECIFICATION

8.01.00 Motor

- i) The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.
- ii) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
- iii) The Motor shall be designed to operate continuously at any speed over the range 20-100 % of rated speed.
- iv) The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.
- v) Motors required to be transferred to DOL, by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL, bypass mode shall be limited to value in motor specifications.
- vi) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.
- vii) The motor insulation shall be designed to accept the applied voltage waveform, within the V_{peak} and dv/dt limits as per IEC-61800-4.
- viii) The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

Other details shall be as given in specification of Electric motors, Volume-II-F1, Section-II.

8.02.00 Power Transformer

Indoor dry type/Outdoor ONAN type, and shall be suitable for rating complying with system details. Drive with integral transformer shall have built-in short-circuit detection and Protection. The transformer (KVA) rating selected shall be minimum 1.2 times the Motor Rating. Other details as given

in sub-section of LT Transformer Specification, Volume-II-F2, Section-II. Oil filled Transformer shall be complying to IS 2026, IEC 60076, IEC 61378.

08.03.00

Power Converter

- i) The static power shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.
- ii) Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.
- iii) All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
- iv) The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range.
- v) All power diodes shall be of silicon type with minimum Vbo rating as 2.5 times the rated operating voltage.
- vi) The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.
- vii) The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.
- viii) The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.
- ix) Offered system shall also take in account the distance between drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 350m.

8.04.00

DC Link Reactor

- i) Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.
- ii) Reactor shall be air-core type, natural cooling and housed in a separate enclosure in ventilated room.

- iii) Reactor shall be suitable for withstanding earth fault continuously and for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.
- iv) Noise level shall not exceed value specified in NEMA TR-1.

8.05.00 **Output Filter**

VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance free and self-healing type.

The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

8.06.00 **By-Pass Feature**

- i) Bypass breaker / contactor-HRC fuse complete with protection, annunciation and metering shall be provided.
- ii) All Variable frequency drives (VFD) having bypass feature shall have motor protection relay along with necessary control and metering etc. Switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended by opening its isolation devices.
- iii) Safety interlock between inverter and bypass breaker/contactors shall be provided such that closing of healthy device is inhibited in case of external fault.

8.07.00 **CT/PT/Meters**

As required for the system offered and shall be suitable for variable frequency operation.

8.08.00 **Local Motor Control Station**

- i) The local motor control station is to be installed in the field near the motor. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.
- ii) Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, the drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current.

9.00.00 PROTECTION, CONTROL, METERING, INDICATION AND ANNUNCIATION

9.01.00 The system vendor shall provide all the necessary system control, protection; alarm equipment and metering for the entire drive system and its auxiliary equipment.

9.02.00 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

9.03.00 Operation Control Panel

- i) Each drive shall be equipped with a front mounted operator control panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc. Also local operation during maintenance should be possible & the same shall be provided inside the panel.
- ii) All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However the parameters such as measurements, setting, and mode of drive etc. Shall be allowed to be viewed without any password.
- iii) Operator console shall have facility / port to connect external hardware such as Lap-top etc. Console shall have facility for upload and download of all parameter settings from one drive to another identical drive for startup and operation.
- iv) Drive system control also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.
- v) User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

9.04.00 Protective Features

The system offered shall incorporate adequate features, properly coordinated for the drive control and for motor but not limited to the following:

- i) Incoming line surge protection.
- ii) Under / Over voltage protection.
- iii) Phase loss, phase reversal protection.
- iv) Programmable Over current Protection and under load protection.
- v) Inverter fault.
- vi) Over frequency operation.
- vii) Ventilation loss.
- viii) Over temperature of equipment.
- ix) Over speed of motor.
- x) Specific motor protection, including motor winding, bearing temperatures, over current, Overload, negative phase sequence, locked rotor and earth fault protections etc.
- xi) System Earth fault protection.
- xii) Over and under frequency, rotor earth fault, field failure protection for synchronous motor
- xiii) Additional protection for drive system

9.05.00 **Control**

The following controls shall be provided as a part of the operators control Panel or through separate switches.

- i) Start/Stop
- ii) Speed Control (Raise/lower)
- iii) Auto/Manual/Test mode
- iv) Local/Remote
- v) Emergency Stop
- vi) Start/Stop for by pass starter (where specified)
- vii) Trip-Remote Breaker

- viii) Sequential switching of filters

9.06.00 Indicators

Vendor shall provide indications as required for normal operation and for easy maintenance, which shall be limited to the following indications:

- i) Motor running
- ii) Motor stopped
- iii) VFD System Fault
- iv) System ready to start
- v) AC mains ON
- vi) Motor over speed
- vii) Rectifier output 'ON'
- viii) Motor zero speed
- ix) Rectifier breaker trip

Above indications may be provided as a part of the operator control panel, i.e., door mounted keypad or through hardwired indicating lamps/LEDS.

Potential free contacts of items i-iv shall be wired separately for remote indications in PLC/DDCMIS system.

9.07.00 Metering

Digital display of the following parameters shall be as a part of the Operator Control Panel, selected by the operator.

- i) Input AC voltage
- ii) Input AC frequency
- iii) Input AC current
- iv) Output voltage
- v) Output current VFD / Bypass
- vi) Output frequency
- vii) Motor thermal state
- viii) Drive thermal state

- ix) Motor speed
- x) Motor energy meter
- xi) DC Link voltage
- xii) Hour Run

Necessary transducer shall be provided with 4-20mA output for indicating motor speed and motor current in PLC/ DDCMIS unless otherwise specified for other parameters.

9.08.00 Audio-Visual Annunciations

- i) The system shall incorporate audio-visual annunciations for protection, for various fault conditions, for the Drive motor, Supply cables, DC Reactor and the Converter, output transformer etc.
- ii) Alarms shall also be included for the failure of various auxiliaries together with identifications of the failing unit, loss of cooling system, various protections devices provided for converter transformer etc.
- iii) Audio-visual window annunciations shall be provided on the front of the panel. All annunciations as required for normal and satisfactorily operation of the drive system shall be included as per vendor standards. These annunciations can be part of operator console panel or separately mounted type.
- iv) Vendor shall include audio-visual alarm as required for normal operations and maintenance of the system but not limited to the following:
 - 1. Rectifier fuse failure
 - 2. Main AC failure
 - 3. Inverter fuse failure
 - 4. Inverter overload
 - 5. Inverter high temperature
 - 6. Cooling system failure
 - 7. Motor failed to start
 - 8. Transformer failure
 - 9. Battery monitoring healthiness
 - 10. Communication and measurement system unhealthy
 - 11. Motor temperature high
 - 12. Harmonic filters monitoring

Common potential free contacts shall be provided for above annunciations and these shall be wired up to terminal block for owner's use for remote alarm and monitoring.

9.09.00 Fault Diagnostic

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available for a period of minimum 4 days (96 hours) after a shut down even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

9.10.00 Maintenance Features

The controller design will incorporate the following maintenance features:

- Modular construction
- All components will be easily accessible.
- Standard diagnostics to aid maintenance personnel. These will include LED or alphanumeric displays, test or measurement points.

10.00.00 EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT

10.01.00 Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps etc. shall operate on 240 volts single phase AC provided by purchaser.

10.02.00 All control circuit shall operate at maximum voltage of 240V AC

10.03.00 Vendor shall include supply of all control transformers, protective devices, required accessories etc. and any other control supply voltage as required for the system shall be derived from the power supply made available by other.

11.00.00 PAINTING

11.01.00 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.



11.02.00 After preparation of the under surface, the panel shall be provided with epoxy based powder coating. Panel finish shall be free from imperfections like pinholes, orange peels, runoff painted.

11.03.00 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

12.00.00 INSPECTION, TESTING AND ACCEPTANCE

12.01.00 During fabrication, the drive shall be subject to inspection by owner, or by an agency authorized by the owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to owner's inspectors.

12.02.00 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of the owner or an agency authorized by the owner. Prior notice of minimum of 4 weeks shall be given to the inspector for witnessing the test.

12.03.00 The routine test shall be conducted on all the drive system. However type test shall be performed on one system of each rating and type unless otherwise agreed between purchaser and manufacturer. For the purpose of testing, drive system shall include input/output transformer (where applicable), switchgears, converter, filters etc.

12.04.00 The routine and type tests to be performed on the drive system shall be as follows :

12.04.01 Routine Tests

a. Visual Inspection

It involves checking of the various equipment/components fault diagnostic unit, wiring, terminals, earthing ratings etc, in line with the approved drawings and visual inspection shall not be limited to the following;

- i) Dimensions and door layout Vis-à-vis the approved drawings
- ii) Degree of protection of cubicles
- iii) Simulation facility of control signals for testing purposes
- iv) Memory function of fault diagnostic
- v) Voltage/Current rating power semiconductor elements
- vi) Cable termination size and number of terminals, cable-supporting etc.



- vii) Accessibility of components
- viii) External signals and indication/alarm signals on converter
- ix) Earthing of cubicles and cubicle doors
- b. Insulation Test
- c. Light load and functional test
- d. Load characteristics test
- e. Load duty test
- f. Checking of Auxiliary devices
- g. Checking the properties of the control equipment
- h. Checking the protective devices
- i. Checking of control and functional requirements
- j. High voltage test
- k. Shaft current/bearing insulation
- l. Automatic restart/re-acceleration
- m. dv/dt test
- n. Efficiency Test
- o. Total Harmonic test
- p. Heat run test
- q. Reflective wave test

12.04.02 **Type Tests**

- a. Allowable full load current versus speed
- b. Efficiency
- c. Temperature rise
- d. EM Immunity
- e. EM Emission
- f. Current sharing

- g. Voltage division
- h. Line side current distortion content
- i. Power factor
- j. Audible noise
- k. Torque pulsation
- l. Motor vibration
- m. Dynamic performance
- n. Current limit and current loop test
- o. Speed loop test capability to ride through voltage less than 80%
- p. Test capability to restart the system and resynchronize converter onto running motor after a voltage interruption

Valid Type test certificate from independent testing agency for similar rated equipment can be accepted for d, e, f, j, k and l. In case of non-availability of valid test certificate, contractor shall conduct type tests as per IS / IEC without any additional commercial implication to prove the design.

ANNEXURE – A

RATINGS AND REQUIREMENTS

Sl. No.	Description	Unit	Specification Requirement
1.0	Type of drive		Inverter (IGBT based PWM controlled) AC drives
2.0	Manufacturer		*
3.0	Application		As per technological requirement
4.0	Type of Motor/Model No. of the VFD		VFD shall be considered as per the technological requirement
5.0	Rating of drive	kW	Squirrel cage induction motor
6.0	Quantity		*
7.0	Rated power factor		*
8.0	Efficiency		*
9.0	Rated output voltage	kV	*
10.0	Full load current	kA	*
11.0	Type of duty		a)100% continuous b) 150% overload for 1 minute in 24 hours
12.0	Quadrants of operation		*
13.0	Full wave rectification		As Defined else where
15.0	Power supply system		
	a)Input power supply		As per system requirement
	b)Variation in voltage		+10%
	c)Variation in frequency		+5%
	d)Combined voltage & frequency variations		10%
	e)System fault level	kA	As Defined else where
	f)Type of earthing		As per system requirement
15.0	Location		Indoor
16.0	Type of cooling		*
17.0	Input and output cables		
	a)Size & type		*
	b)Entry		Bottom
18.0	Dimensions		*
19.0	Degree of protection		IP42
20.0	Power loss ride through time	Sec.	2
21.0	Control characteristics		
	a) Control Method		Drive level control using digital system.
	b) Output freq. range		*
	c) Frequency accuracy		0.01%
	d) Frequency resolution	Hz	0.001
	e) Speed regulation		0.5% of max. speed
	f) Speed range		*
	g)Accelerate/decelerate time		*
22.0	Harmonic limitations		



Sl. No.	Description	Unit	Specification Requirement
	I) Voltage harmonics		
	a) Source side		Maximum 5%
	b) Load side		Maximum 5%
	II) Current Harmonics		
	a) Source side		
	i) 5 th		As per IEC 61000
	ii) 7 th		As per IEC 61000
	iii) 11 th		As per IEC 61000
23.0	Miscellaneous		
	a) Soft-start		Yes
	b) Flying restart		Yes
	c) Auto restart		Yes
24.0	Kinetic buffering		Yes (Preferably for a backup time of 2 sec.)
Note	‘*’ indicated above shall be filled by the Contractor		
	‘***’ Contractor shall furnish the data after placement of order		

3.17.00	Foot operated siren	÷	Yes/No
3.18.00	Repair cages as specified	÷	Yes/No
3.19.00	All platforms and ladders as specified and as required	÷	Yes/No
3.20.00	Lifting lugs, eye bolts etc. required for handling crane parts	÷	Yes/No
3.21.00	Shop tests as specified	÷	Yes/No
3.22.00	Site tests as specified	÷	Yes/No
3.23.00	Erection and Commissioning service as specified	÷	Yes/No
3.24.00	Supervision of erection and commissioning	÷	Yes/No
3.25.00	All equipment, accessories and consumables required upto provisional takeover for erection, testing and commissioning	÷	Yes/No
3.26.00	Final painting	÷	Yes/No
3.27.00	Balancing beam for tandem operation furnished	÷	Yes/No
3.28.00	First charge and further charge upto provisional takeover of oil, lubricants, grease etc.	÷	Yes/No

Part 2 : (TG Hall EOT crane)

Bidder to fill up the particulars in the format as specified below for TG Hall E.O.T Crane) offered, mentioning location.

Sl. No.	Description	Unit		
1.00.00	Technical Particulars			
	i) Design fabrication and testing of crane confirm to standard/code no			
	ii) Type and class of crane			
	iii) Quantity	Nos.		

	iv)	Guaranteed lifting capacity of the main hook	tonnes		
	v)	Guaranteed maximum lifting capacity of the auxiliary hook	tonnes		
	*- The lifting capacity shall be as per cl.no. 10.2, sec 10, volume IIB of the tender specification				
	vi)	Guaranteed maximum lift of the main hook	metres		
	vii)	Guaranteed maximum lift of auxiliary hook	metres		
	viii)	Location (Indoor/ Outdoor)			
	Height of lift (m)		in (m)		
	a) Main hook				
	Above floor				
	Below floor				
	b) Aux hook				
	Above floor				
	Below floor				
	ix)	Maximum speed at full load:			
	a)	Main hoist	mtr/min		
	b)	Auxiliary hoist	mtr/min		
	c)	Trolley cross travel	mtr/min		
	d)	Bridge (long) travel	mtr/min		
	e)	Creep speed of main hoist	mtr/min		
	f)	Creep speed of auxiliary hoist	mtr/min		
	x)	Crane bridge			
	a)	Type			
	b)	Method of fabrication			
	xi)	Trucks (end carriage)			
	1.	Number of trucks	nos		
	2.	Number of wheels per truck	nos		
	3.	Centre to centre distance of wheels of end carriage	mm		
	a)	Inter wheels distance	mm		
	xii)	Trolley:			

	a)	Method of fabrication			
	b)	Centre to centre distance of transverse wheels	mm		
	xiii)	Wheels Truck / Trolley			
	a)	Type			
	b)	Diameter	mm		
	c)	Hardness	BHN		
	d)	Material			
	e)	Type of bearings			
	xiv)	Motor particulars for Rating & Speed	KW /rpm		
	a)	Main hoist			
	b)	Auxiliary hoist			
	c)	Trucks			
	d)	Trolley			
	xv)	Type of brakes for Hoists			
		Trucks			
		Trolley			
	xvi)	Hoisting rope Main / Auxiliary			
		Construction			
		Steel quality (IS) (conforming to IS)			
		Diameter	mm		
		Number of falls			
		Minimum breaking load ()	kg/cm ²		
		Factory of safety			
	xvii)	Crane hooks (Main/Auxiliary)			
	a)	Type & Conforming to IS (relevant IS no. to be indicated)			
	b)	Capacity	Tons		
	c)	Material of construction			
	xviii)	Dynamic wheel loading:			
	a)	Impact vertical	tonnes		

	b) Acceleration	metres/ sec ²		
	c) Deceleration	metres/ sec ²		
	d) Impact Horizontal	Tonnes		
	xix) Static wheel loadings:			
	a) Minimum tones/axle	Tons		
	b) Maximum tones/axle	Tons		
	Rope drums Main Hoist Auxiliary/Hoist			
	a) Diameter	mm		
	b) Thickness of the drum at the bottom of the grooves	mm		
	c) Depth of grooves	mm		
	d) Pitch of rope grooves	mm		
	xx) Diameter of sheaves			
	a) Main hoist	mm		
	b) Auxiliary hoist	mm		
	xxi) Runway rail			
	a) Weight per metre	kg		
	b) Section (sectional piece of each length)	nos.		
	c) Total length of rail	m		
	d) Rail Hardness	BHN		
	xxii) Deflection of crane girder at rated load	mm		
	xxiii) Testing and commissioning			
	xxiv) Type of operation			
	xxv) Provision of Air conditioning to Cabin			
	Material Specification a) Frame b) Wire rope c) Rope drum d) Crane wheel			

2.00.00 For Electrical portion of the TG EOT crane: Refer clause no. 2.28.00 to 2.34.00 of the datasheet of Part-1 Cranes.

3.00.00	SCOPE OF SUPPLY OF ACCESSORIES AND SERVICES		
3.01.00	All structures as specified	:	Yes/No
3.02.00	All drive motors and driving gears as specified	:	Yes/No
3.03.00	Operator's Cabin	:	Yes/No
3.04.00	Provision of Air conditioning to Cabin	:	Yes/No
3.05.00	Pendant Station	:	Yes/No
3.06.00	Radio Remote	:	Yes/No
3.07.00	Portable fire extinguisher (Adequate capacity and relevant type) in operator's cabin	:	Yes/No
3.08.00	Runway rails and trolley travel rails including all clamps, anchors, bolts, nuts, shims, inserts, end stops and other fixtures as specified	:	Yes/No
3.09.00	Runway conductors (DSL) and power insulators, brackets, fixtures etc. collectors complete with all supports	:	Yes/No
3.10.00	Complete electrical work including main disconnect switch, all controls and grounding, protective panels etc. interlocks, with necessary wiring,	:	Yes/No
3.11.00	Spring/rubber buffers for end trucks	:	Yes/No
3.12.00	Lower limit switches for hoists	:	Yes/No
3.13.00	Rail sweep as specified	:	Yes/No
3.14.00	Illumination of crane, operator's cabin etc	:	Yes/No
3.15.00	Protection guards as specified	:	Yes/No
3.16.00	Electric fan in operator's cabin	:	Yes/No

3.17.00	Foot operated siren	:	Yes/No
3.18.00	Repair cages as specified	:	Yes/No
3.19.00	All platforms and ladders as specified and as required	:	Yes/No
3.20.00	Lifting lugs, eye bolts etc. required for handling crane parts	:	Yes/No
3.21.00	Shop tests as specified	:	Yes/No
3.22.00	Site tests as specified	:	Yes/No
3.23.00	Erection and Commissioning service as specified	:	Yes/No
3.24.00	Supervision of erection and commissioning	:	Yes/No
3.25.00	All equipment, accessories and consumables required upto provisional takeover for erection, testing and commissioning	:	Yes/No
3.26.00	Final painting	:	Yes/No
3.27.00	Balancing beam for tandem operation furnished	:	Yes/No
3.28.00	First charge and further charge upto provisional takeover of oil, lubricants, grease etc.	:	Yes/No

		TECHNICAL SPECIFICATION NLC TALABIRA (3X800 MW PHASE-1) DOUBLE GIRDER EOT CRANES FOR TG HALL 150/30T		PE-TS-511-501-A501	
				Rev. No. 00	
				Date : Jun 2026	
TECHNICAL DATA SHEET A					
Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS		
1.0.0		General			
1.1.0		Basic Details			
	a.	EOT Crane	150/30T Double Girder EOT crane		
	b.	Location	TG Hall Building (Indoor)		
1.2.0	a.	Design, fabrication and testing of the crane confirm to standard / code number	Mechanical and Electrical as per IS: 3177-2020 & Structure design in accordance to IS 807:2006 / IS 800:1984.		
	b.	Minimum thickness of Structural members	a) Load carrying members: 8 mm b) Tubes with both ends sealed: 4.9 mm (6 SWG) c) Tubes with unsealed ends: 8mm d) Chequered plates: 6 mm O/P e) Diaphragm/stiffner thickness - 8mm		
	c.	MAXIMUM SPAN/DEPTH RATIO FOR GIRDER:	Plate girders : 18		
	d.	Slenderness ratio	For compression members, the slenderness ratio shall not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio shall not exceed 180.		
1.3.0		Number of crane	Two (2) nos.		
1.4.0		Crane classification	M5 duty for Mechanical and M8 for Electrical as per IS: 3177– (latest edition) & Structural design as per IS 807 – 2006.		
1.5.0		Suitable for outdoor or indoor duty	Indoor		
1.6.0		Capacity			
1.6.1		Main hoist			
	a.	Rated SWL – tonnes	150T		
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL (Safe Working Load)		
	c.	Lift	As per crane clearance diagram attached		
1.6.2		Aux. hoists			
	a.	Rated SWL – tonnes	30T		
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL		
	c.	Lift	As per crane clearance diagram attached		
1.7.0		Span	As per crane clearance diagram attached		
1.8.0		Operation from	Cabin + Pendent Push Button+ Radio remote control		
2.0		CRANE PERFORMANCE			
2.1.0		Crane speed with full load	Full speed m/min	Creep speed m/min	
	a.	Main hoist	1	10% of main speed thru' VVVF drives	
	b.	Aux. hoist	3	10% of main speed thru' VVVF drives	
	c.	Trolley travel (CT)	10	10% of main speed thru' VVVF drives	
	d.	Longitudinal bridge travel (LT)	15	10% of main speed thru' VVVF drives	
2.2.0		Acceleration values for LT motion (bridge travel) and CT motion (trolley travel)	As per IS: 3177 (2020)		
2.3.0		Hook Approaches from C.L. of rails			
	a.	Main hook (non cabin side)	Refer "CRANE CLEARANCE DIAGRAM OF TG HALL EOT CRANES" under compliance drawings.		
	b.	Aux. Hook (non cabin side)			
	c.	Main hook (cabin side)			
	d.	Aux. Hook (cabin side)			
2.4.0		Hand Rail Pipes	32 mm NB heavy duty GI pipes as per IS 1239 having top and bottom rail at height of 1000 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)		
3.0.0		COMPONENT DETAILS			
3.1.0		Bridge girder			
	a.	Type & Quantity	Box type – 2 nos. Material: Mild steel, grade 'BR' of IS 2062		
	b.	Stress consideration	Following to be consider as per IS 807: Static load (dead load), loads due to working load multiplied by dynamic coefficient, two most unfavourable horizontal effects excluding buffer forces.All these loads must then be multiplied by amplifying coefficient		

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	c.	Maximum Limit for Vertical Deflection	Maximum vertical deflection of the girder produced by the weight of the trolley and the rated load shall not exceed 1/900 of the span of the crane.		
	d.	Camber	Girders shall be cambered to an amount approximately equal to the dead load deflection plus one-half the live load (rated load +trolley weight) deflection.		
	e.	Type of connection to end carriage	By fitted bolts		
	f.	Nut & bolts	As per IS:1363, IS:1364 and IS:1367. High Tension Friction grip bolts as per IS: 3757. High Tension Friction grip nuts as per IS: 6623.		
3.2.0		Type of platform required on the bridge	Chequered plate platform 6mm thick over plain as per IS : 3502		
	a.	Length	Full span length		
	b.	Walkways	Access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways.		
	c.	Type of access from gantry girder level to crane bridge	Rung ladder at ends from gantry girder level walkway to crane bridges walkway		
	d.	Type of access to maintenance cage from crane bridges walkway	Rung ladder		
	e.	Type of access to Cabin from crane bridges walkway	By Staircase		
	f.	Provided at both ends	Yes		
3.3.0		End carriage span (wheel base)	As per IS 807 (latest edition)		
3.4.0		Trolley	The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction and should be covered by flooring as far as possible.		
On bottom of trolley frame, on each side a double spring bumper shall be provided to engage stops at each end of the bridge.					
800 mm (clear) with hand railing of height of 1100 mm along the cross over walkways on trolley.					
	a.	Type	Fabricated		
	b.	Method of fabrication	Fusion welded		
	c.	Material	Mild steel, grade 'BR' of IS 2062,100% killed, normalised and ultrasonically tested quality.		
	d.	Other requirements	Upper pulley block shall be approachable for maintenance.		
	e.	Whether jacking pads for lifting trolley provided or not	Yes		
3.5.0		Rope drums	Main hoist (MH)	Aux hoist (AH)	
	a.	Material (Indicate IS)	Seamless pipe ASTM A -106 Gr. B or fabricated rolled section to IS: 2062 Gr. Br &		
	b.	Flange / flangeless	Flanged		
	c.	Numbers provided	One for each hoist		
	d.	Type of grooves	Identical Right hand and Left hand & other details shall be as per IS 3177:2020		
3.6.0		Rope details	Main hoist	Aux hoist	
	a.	Construction	Extra flexible plough steel , 6 x 36 or 6x37 construction		
	b.	Standard conforming to	IS: 2266 (latest edition)		
	c.	Factor of safety	As per IS-3177 : 2020		
	d.	Type of core	Steel	Steel	
3.7.0		Sheaves details	Main hoist	Aux hoist	
	a.	Material	The sheaves shall be of heavy duty with deep flanges made of cast steel and shall be properly grooved to fit the rope and adequately guarded.CS Gr.280-520 IS:1030		
	b.	Type of guards provided	Fabricated from rolled steel plate		
3.8.0		COUPLINGS & SHAFTING			
3.8.1		Coupling details (between motor and gear box)	(for Main hoist, Aux hoist, Cross Travel and long travel)		
	a.	Type	Flexible shock absorbing coupling		
	b.	Guards and enclosures	Provided		
	c.	Coupling material and hardness	All couplings shall be of cast, wrought or from forged steel, tooth portion to be heat treated to hardness HB241-280		

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3.8.2		Coupling details (between gear box and wheels)	Cross Travel (CT)	Long Travel (LT)
	a.	Type	Flexible geared type	
	b.	Guards and enclosures provided	Yes	
3.8.3		Coupling details (between gear box and rope drum)	Main hoist	Aux hoist
	a.	Type	One of the following arrangements will be adopted for connecting the rope drum with the gear- box. 1.Flexible joint, incorporating flexible geared coupling housed within the drum. 2.Fully flexible geared coupling between the drum & gearbox.	
	b.	Guards and enclosures provided	Yes	
3.8.4		Shafting (Output)	Cross Travel	Long Travel
	a.	Factor of Safety	As per IS: 3177-2020	
	b.	Arrangement of lubrication	Grease cups / Nipple	
	c.	Type of lubricant	Grease	
3.9.0		Gear box details		
3.9.1		Hoist Motions	MH	AH
	a.	Type of mounting of gear box	Horizontal / Vertical	
	b.	Classification	Suitable for M5 duty	
	c.	Type of gears	For MH and AH: Helical / Spur For MH Micro and AH Micro: Through VVVF drive	
	d.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication	
	e.	Hardness (BHN) – gear	220 BHN (minimum)	
	f.	Hardness (BHN) – pinion	270 BHN (minimum)	
	g.	Difference in Gear and pinion hardness	Min 20 BHN	
	h.	Materials (gear/pinions)	Main Gears EN 9/ 55C8/ IS2707. Pinions EN 19/EN 24. Hardness conforming to IS: 3177-2020 Gears to be hardened, tempered & heat treated as per IS 4460	
	i.	Casings	Fabricated Fe 410w IS: 2062 Gr Br & stress relieved	
	j.	Noise level	85 db	
	k.	Standard conforming to	IS: 4460 / AGMA	
3.9.2		Travel Motions	CT	LT
	a.	Type of mounting gear box	Vertical/ Horizontal	
	b.	Classification	M5 duty	
	c.	Type of gears	For CT and LT: Helical / Spur For CT Micro and LT Micro: Through VVVF drive	
	d.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication	
	e.	Hardness (BHN) – gear	220 BHN (minimum)	
	f.	Hardness (BHN) – pinion	270 BHN (minimum)	
	g.	Difference in Gear and pinion hardness	Min 20 BHN	
	h.	Materials (gear / pinions)	Main Gears EN 9/ 55C8/ IS2707 . Pinions EN 19/EN 24. Hardness conforming to IS: 3177-2020 Gears to be hardened, tempered & heat treated as per IS 4460	
	i.	Casings	Material of the gear box housing shall be cast or fabricated. The fabricated gear boxes shall be stress relieved before machining.	
	j.	Noise level	85 db	
	k.	Standard conforming to	IS: 4460 / AGMA	
3.10.0		Wheels details	Cross Travel	Long Travel
	a.	Material	Grade C55Mn75 of IS 1570 (Part 1 and Part 2/Sec 2) or 42CrMo4 or equivalent as per IS 3177-2020.	
	b.	Hardness	300 – 350 BHN	
	c.	Depth of hardness	10 mm (min)	
	d.	Process of hardening	Volume hardening	
	e.	Type	Double flanged	
	f.	Min.Numbers provided	4 nos.	8 nos.
	g.	Specification conforming to	IS: 3177-2020	
	h.	Arrangement of lubrication	Grease	
3.11.0		Lifting hooks	Main hoist	Aux hoist
	a.	Type	Ramshorn shank with safety latch swiveling type as per latest edition of IS:5749	Plain with safety latch swiveling type as per latest edition of IS: 15560
	b.	Safe lifting capacity	SWL is 160T as per IS 5749	40 T as per IS: 15560

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	c.	Material	Class II as per IS 1875	Class 3 for hook of grades L & M respectively as per IS 1875:1992 for hooks conforming to IS : 15560
	d.	Standard conforming to	IS: 5749	IS: 15560
	e.	Hook can rotate	Yes	
	f.	Safety latch on hook provided	Yes	
	g.	Locking device on swivelling hook required or not	Provided	
3.12.0		Buffers	Cross travel	Long travel
	a.	Type	Spring loaded type. To be designed to bring the loaded crane (In calculation crane is considered to be loaded with SWL) to rest from speed of 50% of the rated speed.	
	b.	Numbers provided	4	4
	c.	Details of end stop	Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.	
3.13.0		Brakes		
3.13.1		Hoist Motions	Main hoist	Aux hoist
	a.	Type of brake	AC Electro-Hydraulic Thruster operated + DC Electromagnetic	
	b.	Number provided per motor	1+1	1+1
	c.	Braking capacity (% of torque transmitted to the brake drum with full load.)	150%	150%
	d.	Material		
		· Brake liners	Ferrodo liners	
		· Drum	CS IS : 1030 / CL 4 IS : 1875	
		· Springs	As per manufacturers standard	
3.13.2		Travel Motions	CT	LT
	a.	Type of brake (ac / dc / thruster)	AC Electro-Hydraulic Thruster operated + DC Electromagnetic	
	b.	Number provided per motor	1+1	1+1
	c.	Braking capacity (% of motor rated torque before derating)	125%	125%
	d.	Material		
		· Brake liners	Ferrodo liners	
		· Drum	CS IS : 1030 / CL 4 IS : 1875	
		· Springs	As per manufacturers standard	
	e.	Additional brakes for LT motion	Two (2) nos. Hydraulic thruster (foot operated)	
3.14.0		Motors		
	a.	Type	Three phase Squirrel Cage Induction motors to be operated from VFD system shall be suitable for speed range and torque without exceeding temperature rise limits as specified elsewhere in this specification. VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side and shall be suitable for Inverter duty.	
		Design Codes & Standards	1 Three phase induction motors : IS15999, IEC:60034, IS: 12615, IS: 325 2 Single phase AC motors : IS:996, IEC:60034 3 Energy Efficient motors : IS 12615, IEC:60034-30 4 Crane duty motors : IS:3177, IS/IEC:60034 5 Designation of Methods of Cooling of Rotating Electrical Machines: IS 6362 6 Designation for types of construction and mounting arrangement of rotating electrical machines: IS 2253	
	b.	Enclosure	TEFC	
	c.	Numbers furnished	For Main hoist: one no. For aux hoist: one no. For Cross travel: As per bidder's design. For long travel: 2 nos. minimum	
	d.	Voltage, phase and frequency	415V $\pm$ 10%, 3 Ph., 4 wire, 50 Hz, +3/-5 % Combined voltage & frequency variation $\pm$ 10% absolute	
	e.	Class of protection for motor including terminal box	IP – 55	
	f.	Rated capacity (KW)	Motor rating shall be selected keeping margin of 25% over the maximum power requirement. Further, the hoist motors shall be rated for 120% of the design load on the hook at the rated speed.	
	g.	Duration factor/duty	40 % CDF / S-4	

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	h.	Bearings (Motors)	Grease lubricated ball or roller bearings for Horizontal motors Grease lubricated ball or roller bearings or combined thrust and guide bearing for Vertical motors. These motors shall be provided with insulated bearing on at least one side.	
	i.	Class of insulation	Temp rise 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation	
	j.	Number of starts/ hour	150	
	k.	Overload protection for motors provided	Yes	
	l.	Space heater requirements	For motors of rating 30 KW and above. Separate terminal box for space heaters shall be provided.	
	m.	Pull out torque	275% of full load torque	
	n.	Terminal box of motor	-Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation. DOP of terminal box shall be same as motor. -Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated. - The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor. - Rotation at 90 deg	
	o.	Cable glands and lugs	-Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used. -Gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.	
	p.	Earthing points suitable for connection	Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.	
3.15.0		Storm brake	2x50% storm brakes, one each at each end of the bridge, shall be provided for each crane. Storm brakes shall be designed for wind velocity and detail given in project data. Storm brakes shall be truck end mounted, hydraulic rail clamp type of adequate capacity (depending on wind pressure) to be provided. The setting shall include automatic engagement of clamps in case of crane is left idle for five minutes (adjustable).	
3.16.0		Drive system for hoisting		
	a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box	
	b.	Arrangement of drive from pony motor to rope drum (creep speed)	Creep speed through VVVF drive.	
3.17.0		Bearings (for crane hook, Trolley wheels, rope drum, gear box or any other assembly)		
	a.	Type	Antifriction ball / roller bearings	
	b.	Number provided for each	As per assembly requirements	
	c.	Method of lubrication	Centralised grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.	
	d.	Bearing life	not less than 10,000 working hours	
3.18.0		Rails	✓ The rail section shall be as per IS: 3443, grade 50C12 ✓ The rails shall be butt jointed by fusion welding process. Joining of rails shall be by end clamping method. ✓ Trolley travel rail ends shall be curved upwards to stop the trolley smoothly and prevent it from leaving the rails in case of over travel at its maximum speed. ✓ LT wheel stopper (ramp) shall be provided ✓ Max. rail gap shall be 2 mm	
3.19.0		Power conductors (DSL) & Cables		
	a.	Design Criteria	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 2% of rated voltage at motor terminals.	
	b.	Type	LT: PVC shrouded Cu conductor bus bar. Suitable for bay length CT: EPR insulated, copper conductor trailing cables, as per IS: 9968, on the bridge.	

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	c.	LT POWER CABLES	Stranded Copper/ Stranded Aluminum. Minimum 2.5 mm ² for Cu/ Minimum 16mm ² for Aluminum. 1100V grade	
	d.	LT Control Cables	Stranded Copper. Minimum 2.5 mm ² . 1100 Volt grade flexible, heat resistant	
	e.	Guard provided for DSL	Yes	
	f.	CABLE TRAYS	Cable trays shall be ladder/perforated type complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables. Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized. Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm. Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanized. Troughs shall be standard width of 50mm & 75 mm with depth of 25 mm. The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse	
	g.	SUPPORT SYSTEM FOR CABLE TRAYS	Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. All steel components, accessories, fittings and hardware shall be hot dip galvanized. Cable tray support system shall be pre-fabricated out of single sheet. Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079. Cantilever arms of 320 mm, 620mm and 750 mm in length are required.	
	h.	Voltage drop	Max. 3% of rated voltage between the main disconnect switch and motor terminals	
3.20.0		Operators cabin		
	a.	Type of construction	The operator's cabin shall be of structural steel frame and shall be closed type, with AC, fire proof construction and complete with light, fan and seat. The cabin shall be provided with guarding handrails and the floor shall be covered with electric insulating carpet. A staircase shall be provided for access to and exit from the crane walkway.	
	b.	Area and minimum clear height	2500x1850 mm with a head room of 2400 mm	
	c.	Operator's seat	Revolving type	
	d.	Warning gong	A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dB at 3.5 m. One brass gong suspended outside the Cabin and operated from inside.	
	e.	Alarm	A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane.	
	f.	Position of controllers	In front/ side of operator's chair	
3.21.0		Limit switches		
	a.	Type	For MH: Rotary gear + Gravity	
			For AH: Rotary gear + Gravity	
			For CT: Lever type (one way/ two way)	

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			For LT: Lever type (one way/ two way)
	b.	Number provided	For MH: 1+1
			For AH: 1+1
			For CT: 2/1
			For LT: 2
	c.	Material of contacts	Double break Silver Cadmium
	d.	Control voltage / Enclosure	110 V/ IP 55
3.22.0		Isolating switch cum changeover switch	To be provided
	a.	Qty-1 no. Metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs provided at suitable location of crane bay at 1.5 m above crane operating level. "Power On" red indication lamp (LED type) shall be provided.	
	b.	BHEL will provide two number 415 V AC (3 PHASE 4 WIRE) supply feeder only up to isolating cum changeover switch. Any other voltage level (AC/DC) required will be derived by the vendor.	
	c.	Motor starter shall be part of crane control panel.	
3.23.0		Protective Panel	Shall be Provided with isolating switch, power contactor control and indication to switch ON/OFF power to starter panels, control and lighting transformer, Indicating lamps to indicate the live condition of all three phases, main supply ON/OFF lamps on the door, internal illumination. Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater(if applicable), suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF Switches. Terminal blocks shall have 20% spare terminals.
	a.	Material	Cold Rolled Sheet steel 2 mm size, 3mm for Gland Plates (CRCA/HR), 1.6mm: Doors, covers etc
	b.	Numbers and location	One number located in cabin
	c.	DOP	IP 54
3.24.0		Control panel	Indicating lamps to indicate main supply ON/OFF lamps on the door of the panel. Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater(if applicable), suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF Switches. Terminal blocks shall have 20% spare terminals.
	a.	Material	Cold Rolled 2 mm size, 3mm for Gland Plates (CRCA/HR), 1.6mm: Doors, covers etc: sheet steel 2mm size
	b.	Numbers and location	One each for MH, AH, CT and LT located on bridge platform with space heaters.
	c.	Degree of protection	IP 54
3.25.0		Master Controllers (Desk Type)	
	a.	Number of steps	Five speed control points in each direction of hoist motion. Four speed control points in each direction of bridge and trolley motion.
	b.	Voltage & current rating	415 V/10 A
	c.	Type	Heavy duty type having DOP IP54. Release of operators' hand from the controls shall stop motion and set brakes automatically.
	d.	Location	In cabin
3.26.0		Control for Hoists /CT/LT operations	Through separate Variable Voltage Variable frequency drive
	a.	Speed control	Thru' VVVF with minimum 6 pulse design
	b.	Starting torque of VVVF	Up to 400 % typical with/ without encoder
	c.	Starting current	Less than 150 % of rated torque.
	d.	Temperature	VVVF system shall be capable of withstanding up to 50 o C without derating.
	e.	Other requirements for VFD	Necessary input & output devices to be provided to reduce harmonics, as per IEEE519, at supply side of the drive at the switchgear.
	f.	Other requirements for VFD	1024 Pulse in card, droop control for synchronization and crane software. The rating of VVVF shall be decided considering 250% of full load current of respective drive motor. Separate VVVF shall be provided for each motion main hoist, aux. hoist, cross travel & long travel. For long travel, motor shall be grouped in two groups and one VVVF drive for each group shall be considered i.e. two no.s VVVF for long travel.

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	g	Other requirements for VFD	All necessary protections e.g., Input Phase Loss, Earth Fault, Over Voltage, Output Short Circuit, Load Loss, Input Transient Protection, overload etc to be provided.	
3.27.0	a.	Contactors	AC 4 duty for reversing application. AC 3 duty for non-reversing application	
	b.	Switches	AC 23 for motor application, AC 22 for other application.	
	c.	Fuses	HRC	
	d.	Overload relay	Temperature compensated bimetallic with single phasing preventor.	
3.28.0		Power supply	Purchaser shall provide Two (2) nos. 415 V, 3 phase, 4 wire supply at operating floor near A row column at centre of bay length shall be provided. Bidder shall provide change over switch in enclosure to receive above power supply.	
3.29.0		Cable glands	Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS:6121. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and Hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.	
3.30.0		Lugs	Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections	
3.31.0		Transformer	(Dry type, With Insulation Class B or Better)	
	a.	Quantity	2 X 100 % for control, 2 X 100 % for lighting	
	b.	Voltage Rating	Control 415/110V, Lighting 415/240V	
	c.	KVA rating	20% over loading to be considered while sizing the rating	
3.32.0		Illumination		
	a.	In cabin	One (1) nos 40W LED fixture + 2 nos. 24V- 5A-3 pin industrial socket.	
	b.	Over Bridge	Four (4) nos 40W LED type and 4 nos.24V 20A -3 pin Industrial socket	
	c.	Under bridge	Four (4) nos.160 W LED type	
	d.	For inspection of crane components	One (1) portable 40W hand lamp with min. half span length flexible cable for inspection of crane components.	
3.33.0		Fire Extinguisher		
	a.	Type and size	4.5 kg CO2 type	
	b.	Location	One in cabin and Three on bridge	
3.34.0		Maintenance cage	Suitable inspection cages to accommodate two persons to facilitate inspection of	
3.35.0		Mechanical overload protection (Load Cell with digital display)	To be provided for main hoist mode and aux hoist mode. Digital display of load should be clearly visible from operation floor.	
3.36.0		RRC details		
	a.	Joystick type. Microprocessor based digital technology with almost nil hard wiring. Qnty – 3 nos. total (one for each TG EOT +1 no. spare)		
	b.	RRC should be supplied with transmitter unit, receiver unit, encoder unit, decoder unit, interface panel, coupling system, battery unit and any other control gear if required.		
	c.	The equipment should be based upon the microprocessor based digital technology with almost nil hard wiring.		
	d.	The remote unit should communicate up to the distance of approximately 100 meters.		
	e.	The system has to integrate with the control system of crane, which operates at 110 V AC, Single phase.		
	f.	The remote unit should have transmitter which can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type.		
	g.	Frequency allotment for radio remote unit from Govt. of India, Dept. of Telecommunication or any other agency shall be the responsibility of supplier.		

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	h.	The transmitter and receiver unit should have its own frequency and address code with each system having its own security code so that one particular set becomes unique and there is no interference from any other remote unit device. A microprocessor should check all security codes. The processor should have its own watchdog circuit. The receiver FM band should be sufficiently narrow to allow only passing of desired frequency and valid command. Any error should shut down the system immediately.	
	i.	The remote unit should have safety key to prevent any unauthorized operation. All the crane operations should stop at once the communication breakdown occurs.	
	j.	On local unit (receiver side), the system should be provided with one selector switch so that EOT crane can be operated either from Operator cabin or radio remote unit.	
	k.	The receiver unit along with I/O interface unit should be able to bear the vibrations and shocks encountered in normal usage of EOT crane.	
	l.	The system should have very fast response time.	
3.37.0		Pendent Push buttons station	Movable and retractable type. Emergency stop, start, lights, main and creep speed for up & down, forward & reverse for Cross travel and long travel, alarm, selector switch (for mode of operation), glow type push buttons to be provided. Indicative marking for easy operation shall be provided. 1.Suitable for IP 55 protection 2.Ambient temp (-25 to 60 deg C) 3.Pendant cable shall be multicore EPR flexible. 4.PVC coated steel wire rope for pendant shall be 2 mm.
3.38.0		Sweep	Sweep shall be attached to the end carriages and to the trolley to remove foreign materials from the rails.
3.39.0		Whether tandem operation envisaged	No
3.40.0		Lifting Beam & its capacity	NA
3.41.0		Anti Collision device	Suitable anti-collision device of two cranes, alongwith stoppers at both the gable ends.
3.42.0		Lubrication	
	a.	Provisions shall be made for proper lubrication of all parts.	
	b.	Bearings shall be provided with means of pressure lubrication.	
	c.	The crane shall be provided with all necessary lubrication fittings.	
	d.	Lubricating points shall be located for easy and safe access without the necessity of removing guards or other parts. Lubrication lines shall be securely fastened to the cranes structure and shall be located to provide the maximum protection and so that ordinary repairs can be made without removing the lines.	
	e.	The crane shall be provided with a centralized lubrication system of reputed make. This system shall be manually operated, complete with a manual pump, reservoir, supply lines, connectors, valves, and discharge lines to all bearings. System shall be centralized lubrication type with at least, one pump mounted on the trolley and one on each of the crane bridge with supply line for connection to all lubrication points. .	
	f.	Metering valves with indicators shall be provided for all points of grease application and shall be mounted at readily visible and accessible locations.	
	g.	All piping shall be made of suitable metal tubing with flexible hoses where required.	
3.43.0		DSL phase indicating lamps	to be provided on both side of bay length and after isolation switches in maintenance bay.
3.44.0		Consumables	The Bidder's scope includes requirements of consumables such as oils, lubricants including grease, servo fluids, cadmium compounds, gases and essential chemicals etc till handing over
3.45.00		Electrodes	Radiography quality, covered electrodes with heavy covering as per IS : 814 and relevant requirements of ASME Sec. IX and IIC. Bare Electrodes as per IS:7280 and flux wire combination as per IS : 3613.
3.46.00		Siren	One (1) heavy-duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator's cabin for TG hall EOT. For other cranes same shall be from pendent.

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3.47.00		Other requirements	1. Lifting lugs, eye bolts etc. for handling of crane parts- to be provided by crane supplier 2. All equipment, accessories and testing and upto provisional takeover consumables required for erection-to be provided by crane supplier 3. First charge and further charge upto provisional takeover of oil, lubricants, grease etc- to be provided by crane supplier		
3.48.00		Permissible tolerance -	a) Difference in levels of crane rail top measured between two adjacent columns: 2 mm b) Crane rail gauge: ± 3 mm c) Relative shift of ends of adjacent rails in plan and elevation after welding: 1mm d) Deviation of crane rail axis from centre line of web of supporting girder: ± 3 mm		
Note:-					
1	Material of all Structural steel plates and rolled section shall be Mild steel, grade 'B' of IS 2062				
2	The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles, Buffers Electric Motors, Controls, Switch Board and cabling, horns, warning lights, Limit switches etc. Any item not mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included.				
3	Trolley stops of spring type to be mounted independently on bridge rails to prevent trolley from running off.				
4	Buffers to be designed to bring the loaded crane to rest from a speed of 50% of the rated speed.				
5	Suitable guard to push forward or off the rail track any object placed across to be provided. Suitable guards to live electrical wirings downshop lead.				
6	Necessary access ladders shall be provided for access on to crane bridge platform from the gantry girder level, from crane bridge platform to trolley platform and from operating floor of pump to gantry girder level.				
7	The lifting tackle shall consist of a safety type lower pulley block, hook, necessary sheave and flexible steel wire ropes. The lower block sheaves and ropes shall be of adequate design and size to handle the specified loads.				
8	Training to customer for 4 Mandays is also in Bidder scope.Necessary arrangement of training including stay and travel shall be bear by Vendor.				
9	Each crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes for both the hooks, year of manufacture, crane serial number and manufacturer's name.				

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TECHNICAL DATA SHEET B					
(SUCCESSFUL BIDDER TO FILL AFTER PLACEMENT OF ORDER)					
Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS		
1.0.0		COMPONENT DETAILS			
		Bridge girder			
	a.	Size			
	b.	Width			
	c.	Length			
2.0.0		Trolley			
	a.	Centre to centre distance of wheels (on the same rails)			
3.0.0		Rope drums	Main hoist	Aux hoist	
	a.	Dimensions in mm length and diameter (PCD)			
	b.	Number of grooves			
	c.	Diameter on bottom of grooves			
4.0.0		Rope details	Main hoist	Aux hoist	
	a.	Grade			
	b.	Diameter in mm			
	c.	Breaking strength			
	d.	Tensile designation			
	e.	Number of falls			
	f.	Length of rope			
3.4.0		Sheaves details	Main hoist	Aux hoist	
	a.	Diameter of main sheaves in mm on Root			
	b.	Diameter of Equalizing sheaves (in mm) on Root			
3.5.0		COUPLINGS & SHAFTING			
3.5.1		Coupling details (between motor and gear box)	(for Main hoist, Aux hoist, Cross Travel and long travel)		
	a.	Size & Torque rating			
3.5.2		Coupling details (between gear box and wheels)	Cross Travel (CT)	Long Travel (LT)	
	a.	Size & Torque rating			
3.5.3		Coupling details (between gear box and rope drum)	Main hoist	Aux hoist	
	a.	Size			
3.5.4		Shafting (Output)	Cross Travel	Long Travel	
	a.	Diameter in mm			
	b.	Number of support bearings			
	c.	Type of support bearing			
	d.	Max unsupported length of shaft in mm			
3.6.0		Gear box details			
3.6.1		Hoist Motions	MH and MH Micro	AH and AH Micro	
	a.	Total number of reductions			
	b.	Type of gears for MH and AH			
	c.	Reduction ratio			
	d.	Hardness (BHN) – gear			
	e.	Hardness (BHN) – pinion			
	f.	Difference in Gear and pinion hardness			
	g.	Materials (gear/pinions)			
3.6.2		Travel Motions	CT and CT Micro	LT and LT Micro	
	a.	Total number of reduction			
	b.	Type of gears			
	c.	Reduction ratio			
	d.	Hardness (BHN) – gear			
	e.	Hardness (BHN) – pinion			
	f.	Difference in Gear and pinion hardness			
	g.	Materials (gear / pinions)			
3.7.0		Wheels details	Cross Travel	Long Travel	

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	a.	Material		
	b.	Hardness		
	c.	Depth of hardness		
	d.	Tread diameter in mm		
	e.	Tread width in mm		
	f.	Numbers provided		
3.8.0		Lifting hooks	MH	AH
	a.	Material		
3.9.0		Brakes		
3.9.1		Hoist Motions	MH	AH
	a.	Diameter of brake in mm		
	b.	Torque rating Kg. M		
	c.	Braking torque actually required		
	d.	Braking distance in mm		
	e.	Thruster material		
3.9.2		Travel Motions	CT	LT
	a.	Dia of brake in mm		
	b.	Torque rating KgM		
	c.	Braking torque actually required		
	d.	Thruster material		
	e.	Braking distance in mm		
3.10.0		Rails	CT	LT
	a.	Weight per metre		
	b.	Top width in mm		
	c.	Height in mm		
3.11.0		Motors		
	a.	rating	For Main hoist: For aux hoist: For Cross travel: For long travel:	
	b.	Speed (rpm)		
	c.	Contactors for motor		
	d.	Spacing between gland plate & centre of bottom terminal stud		
	e.	Minimum inter-phase and phase-earth air clearances with lugs installed		
	f.	Space heater requirements details		
	g.	Overload protection details		
3.12.0		Limit switches		
	a.	Rating of contacts		
3.13.0		Protective Panel		
	a.	Dimension		
3.14.0		Control panel for MH, AH, CT and LT		
	a.	Dimension		
3.15.0		Slings, suitable for load & overload test of EOT Crane & lifting beam (to be supplied alongwith load test certificate for joint at 2 X rated capacity)		
	a.	Length		
	b.	Size		

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COMPLIANCE DRAWINGS

LIST OF DRAWINGS

- 1 CRANE CLEARANCE DIAGRAM OF TG HALL EOT CRANES

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ANNEXURE A: REQUIREMENTS FOR HEALTHINESS CHECK			
	Besides the scope of work mentioned in quarterly and annual schedule, any other checks as deemed necessary to ensure healthiness of the crane shall be performed. Detailed report along with repair, replacement of parts as required shall be submitted to BHEL after each visit, for further maintenance work by BHEL.		
S. No.	Equipment/Item	Scope of work	Schedule
1	Bridge and Trolley wheel assembly	Checking for wear, flat spots and cracks in flange. Ensure drive wheels are of the same diameter.	Quarterly
2	Runway rail	Checking alignment and elevation of rail track. Check rail clamp, bolts, blocks	Quarterly
3	Machine Bolts	Checking all foundation bolts of Electrical and Mechanical equipment for tightness.	Quarterly
4	Structural Bolts	Checking for tightness. They should also be checked after the first month of operation.	Quarterly
5	Flexible Couplings	Checking pins and teeth for wear, cleaning and greasing.	Quarterly
6	Cross-shaft Plummer Blocks	Checking oil seals for cleaning.	Quarterly
7	Trolley Collectors	Checking of cable trolleys / cabling / chain for connection of trolley wheels through entire length of span.	Quarterly
8	Brakes	All Brake assembly will be checked for loose connection, earthing connection, linings for wear, leakages and adjustments to ensure brake is not rubbing the brake drum during operation. Checking for greasing pins and operation adjustment of brakes.	Quarterly
9	Resistor Connections	Checking, tightening connections at grid joints and at cable terminations.	Quarterly
10	Radio remote controller, Master controller, Pendant	Checking of all connection at push buttons, master controllers contact tips, cams and terminals & functional checks.	Quarterly
11	Panels	All Panels will be checked for loose connection and contactor contacts, components including VVVF's , DBR healthiness.	Quarterly
12	Electrical Motors	All motion motors connection will be checked for loose contacts in terminal box loose crimping of wire lugs, loose contacts on slip ring assembly with carbon brush. Earthing connection with motor.	Quarterly
13	Safety Switches	All limit switches will be checked for desired operation and limits. Emergency switches will be checked.	Quarterly
14	Main Current collectors, LT DSL	Checking of worn collector shoes, sag in main runway wiring, ensuring contact is kept through entire length runway properly.	Quarterly
15	Electrical connections	Checking throughout electrical equipment for loose connection such as selector switches, junction boxes, min isolator switch etc.	Quarterly
16	Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.	Quarterly
17	Operational check of crane	Trolley will be checked for idle operation, for brake operation, limit switch operation & safety switch operation. All motor currents will be checked on no load. Check for abnormal sound /jerk during operation.	Quarterly
18	Gear Boxes	Oil seals will be checked for replacement. Gear and pinion teeth will be checked. Grease/ Oil check.	Annually
19	Motor	All motors' insulation test and meagre test will be carried out.	Annually
REQUIREMENTS FOR HANDING OVER OF CRANES			
1	Handing over of crane/s to End Customer, in smooth and working condition (after closing all punch points) , signing of protocols for hand over shall be in bidder's scope. This shall be carried out within the Guarantee period for which bidder shall be informed.		
2	Any item/s, manpower & services required for closure of punch point and hand over shall be in bidder's scope. For item/s refer sl no 3 below.		
3	Unused Operation & Maintenance spares, as available, during closure of punch point to facilitate handing over of cranes shall be issued by BHEL to the bidder. However bidder at their own discretion may also envisage suitable spares or additional quantity that may be required to facilitate handing over. For list of Operation & Maintenance spares being purchased by BHEL refer sl no 43 of BILL OF QUANTITY.		

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PERFORMANCE GUARANTEES TO BE DEMONSTRATED AT SITE AS PER IS-3177.	
S.N.	DESCRIPTION OF TESTS TO BE PERFORMED
1	Speed test at rated load for hoisting, CT and LT mechanism.
2	Brakes test
3	Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
4	Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.

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STANDARD MANUFACTURING QUALITY PLAN FOR DOUBLE GIRDER EOT CRANE

	MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN						SPEC. NO:				DATE:	
			CUSTOMER:						QP NO.:				DATE:	
			PROJECT:						PO NO.:				DATE:	
			ITEM: DOUBLE GIRDER EOT CRANES FOR TG HALL				SYSTEM: EOT CRANES		SECTION:				SHEET 1 OF 8	
SL NO.	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			10
					M	C/N					D	M	C	N

1.0 MATERIAL:														
1.1	Steel Plates (Box Girder, End Carriage, Trolley & Gear Casing ,Fabricated Rope Drum)	1.Chemical & Physical	Major	Chemical & Physical	100%	1/Heat	APPD. DRG / DATA SHEET	APPD. DRG / DATA SHEET	TC	√	P	V/ W	V	Refer Note 12
		2. NDT	Major	UT (25mm & above thickness)	100%	100%	ASTM A435 / A578 LEVEL B	ASTM A435 / A578 LEVEL B	TC/ NDT Report	√	P	V/ W	V	Refer Note 13
1.2	Round Bars (For Pinion ,Gear ,Axles & Shafts)	1. Chemical & Physical	Major	Chemical & Physical	100%	-	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V	V	Refer Note 14
		2. NDT	Major	U.T	100%	-	ASTM A 388-2007	UT PROCEDURE	NDT Report	√	P	V	V	For UT procedure refer Note 4
1.3	Forgings (For Gears, Wheels)	1. Chemical & Physical	Major	Chemical & Physical	100%	1/Heat	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V/ W	V	Refer Note 12 & 14
		2. NDT	Major	U.T	100%	-	ASTM A 388-2007	UT PROCEDURE	NDT Report	√	P	W	V	For UT procedure refer Note 4
1.4	Casting for Gear	1. Chemical & Physical	Major	Chemical & Physical	100%	-	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V	V	
		2.NDT	Major	U.T	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	NDT Report	√	P	V	V	For UT procedure refer Note 4
1.5	Pulley & Brake Drums	1. Chemical & Physical	Major	Chemical & Physical	100%	-	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V	V	
		2.NDT	Major	U.T (only boss area)	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	NDT Report	√	P	V	V	For UT procedure refer Note 4
1.6	Seamless Pipe for Rope Drum	1. Chemical & Physical	Major	Chemical & Physical	100%	-	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V	V	
		2.NDT	Major	U.T	100%	-	ASTM E 213	ASTM E 213	NDT Report	√	P	V	V	For UT procedure refer Note 4
			Major	Macro Etching, Flattening for Seamless Pipe	100%	-	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V	V	
2.0	BOUGHT OUT ITEMS													
2.1	Hook	Forging Raw material	Major	Visual Check	100%	100%	APPD. DRG. / DATA SHEET	No Visual defect	IR	√	P	W	V	
			Major	UT after forging	100%	100%	ASTM A 388-2007	UT PROCEDURE	NDT Report	√	P	W	V	Refer Note 15
		Heat treatment	Major	Heat treatment after forging	100%	-	Mfg. Std. / Drg	Mfg. Std. / Drg	HT Chart	√	P	V	V	Refer Note 16

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SL NO.	COMPONENT & OPERATIONS	CHARACTERIST- ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			10
					M	C/N					D	M	C	N
		Chemical test	Major	Chemical integral test piece.	1 Per Heat/Batch	-	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	TC	√	P	V	V	
		Physical test	Major	Tensile test on integral test piece after heat treatment	1 Per Heat/Batch	1 Per Heat/Batch	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	I.R	√	P	W	V	Refer Note 17
		Macro etching	Major	Grain Size	100%	-	ASTM E 112	Grain size 6 or final	TC	√	P	V	V	
		NDT before Proof Load	Major	UT	100%	-	ASTM A 388-2007	UT PROCEDURE	NDT Report	√	P	V	V	For UT procedure refer Note 4
			Major	DPT	100%	-	ASME Sec V	ASME SEC. VIII, Div-1, Append. - 8	NDT Report	√	P	V	V	
		Proof Load Test	Major	Proof Load Test	100%	100%	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	I.R	√	P	W	V	Refer Note 18
		NDT after Proof Load (UT only shank portion)	Major	U.T & MPI after Proof Load Test	100%	100%	ASTM A 388-2007 / ASTM E 709-2007	ASTM A 388-2007 / ASTM E 709-2007	NDT Report	√	P	W	V	
		Identification Punch	Major	Visual	100%	100%	—	—	I.R	√	P	H	V	Refer Note 20
2.2	Wire Rope & slings	Visual & Breaking Strength	Major	Type, grade, breaking strength & visual , Diameter	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	Mill T.C.	√	P	V	V	
2.3	Rails	Chemical & Tensile , Cross section , Hardness , Dimension	Major	Chemical & Tensile, Hardness, Dimension	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC	√	P	V	V	
3.0	ELECTRICAL ITEMS													
3.1	Transformer (Control transformer, Light transformer etc.)	Make , Rating	Major	Visual	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	IR	√	P	V	V	
		Routine Test	Major	Doc. Review	100%	-	Mfg. Catalogue	Mfg. Standard	TC	√	P	V	V	

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SL NO.	COMPONENT & OPERATIONS	CHARACTERIST- ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			10
					M	C/N				D	M	C	N	

3.2	SFU , MCCB , MCB , CONTRACTORS , DSL, RELAYS , FUSES , RESISTENCE BANK,HOOTER, PUSH BUTTONS, indicating instruments , junction box, Limit Switches	Make / Rating / Type / Size	Major	Visual	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	IR	√	P	V	V	
		Functional / Continuity Check	Major	Operational	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	IR / COC	√	P	V	V	
3.3	Motor	Type, Rating, Make, Size	Major	Visual	100%	-	CUSTOMER approved BOI list & ADS / DRG		Mfg. TC	√	P	V	V	Refer Note 19
		Routine Test / Clearance of QP for Motor above 50 KW	Major	Measurement	100%		IS: 325 / App. Data sheet/CUSTOMER ADS	IS: 325 / App. Data sheet/CUSTOMER ADS	COC / Mfg T.C. (As per Note-3)	√	P	V	V	
3.4	Brakes	Make,Type,Rating	Major	Measurement	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC		P	V	V	
		IR, HV, Functional Test	Major	Measurement	100%	-	MFG. STD.	MFG. STD.	TC	√	P	V	V	
3.5	VVVF Drive	Type, Rating, Make,	Major	Visual	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC/ COC	√	P	V	V	
		Routine Test	Major	Measurement	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC	√	P	V	V	
3.6	Cables (Power / Control / Trialing / Flexible)	Make, Type, Size	Major	Visual	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC	√	P	V	V	
		Routine Test	Major	Measurement	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC	√	P	V	V	
3.7	Radio Remote, Master Controller, Pendent Station, Switches	Make / Rating / Type / Functional	Major	Visual	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC / COC	√	P	V	V	
3.8	Anti - Collision Device , Cable Gland & lugs , Rectifier ,Lamps, Load cell, Illumination and Earthing material	Make / Type	Major	Visual	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC/ COC		P	V	V	
4.0	OTHER BOUGHT OUR ITEMS													

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					M	C/N				D	M	C	N	
4.1	Bearings	Type & Size	Major	Verification	100%	-	Appd.drg./ Mfr's catalogue	Appd.drg./ Mfr's catalogue	TC / IR / COC	√	P	V	V	
4.2	Tools and tackles	Verification of type size / rating	Major	Verification	100%	-	As per PO / BBU	APPD DRG / DATA SHEET	TC / COC	√	P	V	V	
4.3	Spares (Mandatory / recommended spare / commissioning spares)	Verification of make, type, size , rating	Major	Review Of Internal Inspection Reports / Mfr's TC / COC	100%	-	Approved Spare List	APPD DRG / DATA SHEET	IR / COC	√	P	V/W	V/W	Refer Note 21
5.0	IN PROCESS : FABRICATED COMPONENTS : GIRDER, END CARRIAGE, TROLLEY, GEAR BOX CASING , FABRICATED ROPE DRUM													
5.1	Welding	WPS, PQR & WPQ	Major	Review of Document	100%	-	ASME SEC IX	ASME SEC IX	As ASME Format	√	P	V	V	Refer Note 22
5.2	Weld Fit Up & Edge Preparation	Dimension	Major	Dimension	100%	-	Mfg. Drg.	Mfg. Drg.	I.R	√	P	V	V	
5.3	Fillet Weld	NDT	Major	DPT on Fillet Weld	100%	-	ASME - Sec. V	ASME SEC. VIII , Div-1 , Append. - 8	NDT Report	√	P	V	V	Refer Note 23
5.4	Butt Weld (Girder ,End-carriage, Trolley & Fabricated Rope drum, if applicable)	NDT	Major	Radiography Test / Gamma Ray	Refer Note 24	-	ASME - Sec. V	ASME - Sec. VIII,Div-1, Cl.- UW-51 & 52	NDT Report	√	P	V	V	
				DPT on Butt Weld	100%	10%	ASTM E165	No Relevant Indications	I.R	√	P	W	V	10% random witness by BHEL
5.5	Heat Treatment (SR) of Rope drum and Gear Box Casing	Mechanical	Major	Review of SR chart/Test Report	100%	-	Appd Drg./ Relevant Std.	Appd Drg./ Relevant Std.	SR Chart	√	P	V	V	
5.6	Cabin (as applicable), Platform, Hand railing	Dimension	Major	Dimension	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	I.R	√	P	V	V	
5.7	Fabricated Components (Girders, End Carriages & Trolley, end stopper)	Visual & dimensional	Major	Dimensional & Visual Check	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	I.R.	√	P	V	V	At the Time of Final Insp. Of Crane
6.0	IN PROCESS INSPECTION OF MACHINED COMPONENTS													
6.1	Pinions, Gear & Wheel	1.Dimensional Check	Major	Measurement	100%	-	Mfg Drg / Data sheet	Mfg Drg / Data sheet	I.R	√	P	V	V	
		2. Heat Treatment	Major	Heat Treatment chart	100%	-	Material specification/ Mfg drg	Material specification/ Mfg drg	HT Chart	√	P	V	V	Refer Note 25
		3. Hardness	Major	Measurement	100%	100%	Mfg Drg / APPD DRG / DATA SHEET	Mfg Drg / APPD DRG / DATA SHEET	I.R	√	P	W	V	
		4. NDT	Major	DPT on teeth	100%	-	IS:3658-1981 / ASME - Sec. V	NO CRACKS & LINEAR INDICATION	NDT Report	√	P	V	V	

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1	2	3	4	5	6		7	8	9	*	**			10
					M	C/N					D	M	C	
6.2	Hardness Difference (Pinion & Gear)	Hardness	Major	Mechanical	100%	-	APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC	√	P	V	V	
6.3	Rope Drum	1.NDT & Dimensional Check	Major	DP test on fillet weld & Dimension	100%	-	ASME SEC VIII Div -1 / Mfg. Drg.	NO RELEVANT INDICATION	NDT Report	√	P	V	V	
		2.NDT	Major	DP test on Groove after machining	100%	-	IS: 3658-1981 / ASME - Sec. V	NO RELEVANT INDICATION	NDT Report	√	P	V	V	
6.4	Pulley & Brake Drums	1.Visual & dimension	Major	verification	100%	-	Mfg. Drg	Mfg. Drg	I.R.	√	P	V	V	
		2. NDT	Major	DPT after machining	100%	-	ASME - Sec. V	NO RELEVANT INDICATION	NDT Report	√	P	V	V	
6.5	Assembled Gear Box	1. Visual & Dimensional	Major	Visual & dimensional	100%	-	Mfg. Standard	Mfg. Standard	I.R.	√	P	V	V	
		2. NDT	Major	DPT on Fillet Weld	100%	-	ASME - Sec. V	NO RELEVANT INDICATION	NDT Report	√	P	V	V	
		3.Mechanical	Major	Backlash ,Contact Pattern	100%	-	APPD DRG / DATA SHEET /Mfg. Std.	APPD DRG / DATA SHEET /Mfg. Std.	I.R	√	P	V	V	
			Major	Reduction Ratio , No Load Run Test For Check of Oil Leakage / Temp. Rise, Vibration & Noise	100%	100%	Approved Drawing /Data Sheet/Mfg. Std	Approved Drawing /Data Sheet/Mfg. Std	I.R.	√	P	V/W	V	Refer Note 26
6.6	DSL Guard	Dimensional	Major	Dimension	100%	-	Mfg. Drg.	Mfg. Drg.	I.R.	√	P	V	V	
7.0	FINAL INSPECTION													
7.1	CONTROL PANEL With VVVF Drive	Identification of all Elect. Components, Cable laying / Dressing/ Feruling /Terminations Dimensional, Functional , HV, IR, interlocks, Protection DOP	Major	Visual, dimensional, Operational & Functional Check , HV,IR, Painting	100%	100%	IS:3177 / APPD DRG / DATA SHEET	IS:3177 / APPD DRG / DATA SHEET	I.R	√	P	W	W	Refer Note 27
		Paint Shade/ Thk/ Adhesion	Major	Visual / DFT Check	100%		APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	TC	√	P	V	V	Refer Note 28

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SL NO.	COMPONENT & OPERATIONS	CHARACTERIST- ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			10
					M	C/N					M	C	N	
7.2	EOT crane assembly with control panel, Master Controller / Remote Controller Pendent Station (At Works)	Visual & dimensional	Major	Dimensional ,Span, Diagonal & Wheel Base Dimension, LT Stopper Dimension	100%	100%	IS 3177 / APPD DRG / DATA SHEET	IS 3177 / APPD DRG / DATA SHEET	I.R.	√	P	W	W	Refer Note 29
		Operational	Major	(1) Speed & Current Measurement at No Load for Hoist & CT/LT motion (2) Speed & Current measurement at SWL of Hoist & CT motion (3) Over load test (125%) of SWL for Hoist motion (4) Deflection test at SWL (5) Operation Check of Brake at SWL (6) Interlock & Functional test (7) Verification of breaking path (calculated), under bridge Clearance (difference Of It wheel bottom to Girder bottom)	100%	100%	APPD DRG / DATA SHEET / IS 3177	APPD DRG / DATA SHEET / IS 3177	I.R.	√	P	W	W	Refer Note 30
8.0	Lifting beam (if applicable for tandem operation) - at works	Measurement	Major	Dimension, Visual and load /overload test	100%	100%	APPD DRG / DATA SHEET / IS 3177	APPD DRG / DATA SHEET / IS 3177	IR	√	P	W	W	
9.0	Cleaning & painting	Paint Shade / DFT	Major	Visual , DFT Check	100%		APPD DRG / DATA SHEET	APPD DRG / DATA SHEET	IR	√	P	V	V	
10.0	Review of QA documentation						As per approved QAP			V	V	V	V	
11.0	Packing of components	Packing Soundness	Major	Visual	100%	100%	APPD DRG / DATA SHEET /Packing specification	APPD DRG / DATA SHEET /Packing specification	IR	√	P	W	V	Refer Note 6

- NOTES:
- 1) Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.

2) X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 or equivalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.

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1	2	3	4	5	6		7	8	9	*	10
					M	C/N			D	**	
										M C N	

- 3) Performance of electrical & control devices along with the interlocks, protection & sequence to be checked after crane assembly at works.
- 4) Vendor's UT Procedure from NDT Level II to be submitted to BHEL for approval.
- 5) Following to be noted for packing:
 - a) Packing shall be suitable for storage at site in tropical climate conditions.
 - b) For export job, packing shall be as per BHEL seaworthy packing specification.
 - c) Photographs of items duly placed inside the box just before the final packing and photographs of the box just before dispatch to be sent to BHEL purchase group for review before issuing MDCC.
- 6) In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/verified by supplier's TPI.
- 7) The latest revisions/year of issue of all the standard indicated in the QP shall be referred.
- 8) Blank.
- 9) Blank.
- 10) The heat no. /plate identification no. shall be transferred on all major cut pieces of the MS plate for proper correlation, cutting plan of each plate shall be maintained for proper traceability.
- 11) Welder no. shall be punched near butt weld joints, the welding plan of each fabricated item shall be maintained.
- 12) In absence of co-related TC, check testing shall be witnessed on samples selected by Main contractor.
- 13) Co-related Mill TC inclusive of UT will be reviewed by BHEL/CUSTOMER, In absence of UT conformance in Mill TC, then UT will be witnessed by BHEL. For UT procedure refer Note 4.
- 14) Mech. Properties against H.T condition if applicable against respective Material standard/Grade. Hardness test report review after applicable Q & T condition.
- 15) For MH Hook, UT in proof machined condition and AH Hook in grinding condition. For UT procedure refer Note 4
- 16) HT chart review for Main Hook & AH Hook.
- 17) Test Piece will be drawn from top of shank portion to be identified by BHEL and CUSTOMER.
- 18) W - FOR MAIN HOOK, & AH Hook (Cap. >15T). For UT procedure refer Note 4.
- 18.1) In case of Indian Manufactured Hook : Proof Load test and NDT test (UT & MPI/PT) shall be witnessed by BHEL-CQS/Third Party/Customer.
- 18.2) In case of imported Hooks:
 - a) Proof load test & NDT of hooks before EOT crane load test may be jointly witnessed by a customer/ third party / IDLR approved Laboratory in India OR
 - b) TPIA viz. M/S Lloyds Inspection Agency, M/S Bureau Veritas, M/s DNV, M/s TPL etc. (duly approved by Customer) shall be appointed for proof load test & NDT at the country of origin. customer shall witness proof load test and NDT remotely. Bidder to submit Surveyors details signed by TPIA & main contractor in attached format(with photo), Copy of Relevant educational and NDT certificates and CV with experience details for TPIA and surveyor approval.
- 18.3) Bidder has to include scope of inspection of main hook by reputed third party inspector in case of inspection being done at foreign location. Charges of Third party inspection at foreign location shall be borne by bidder.
- 19) For Motors of 50kW rating and above Routine Test will be witnessed by BHEL and Type test Certificate for identical frame size will be reviewed for validity and conformance. For below 50kW rating routine tests to be witnessed by supplier of crane and type test Certificate for identical frame size will be reviewed for validity and conformance. Photocopies of Type Test Certificates are acceptable but shall be authenticated by Manufacturer. SQP of Motor: PE-QP-999-Q-007, REV-04 Dated 17.04.2021 (MOTORS 55 KW & ABOVE) & PE-QP-999-Q-006, REV-02 Dated 17.04.2021 (MOTORS UPTO 55 KW)
- 20) Identification by BHEL/Customer
- 21) V/W for items as per the Quality Plan
- 22) Welder/procedure qualification will be witnessed by Customer/ BHEL as per appd. WPS. In case the BHEL/NTPC/Lloyds /any other renowned approving agency already available, and doing the job, requalification is not required.
- 23) DP test of fillet weld for rope drum to be conducted after final machining.

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Reviewed by:			Reviewed by:		

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

	MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN						SPEC. NO:			DATE:	
			CUSTOMER:						QP NO.:			DATE:	
			PROJECT:						PO NO.:			DATE:	
			ITEM: DOUBLE GIRDER EOT CRANES FOR TG HALL				SYSTEM: EOT CRANES		SECTION:			SHEET 8 OF 8	
SL NO.	COMPONENT & OPERATIONS	CHARACTERIST- ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS
1	2	3	4	5	6		7	8	9	*	**		10
					M	C/N				D	M	C	

- 24) 100% in Tension Zone, 25% in Compression Zone & 100% for rope drum Seam weld. RT before Stress relieving. RT Film shall be reviewed by BHEL/Customer
- 25) Heat treatment Chart to be reviewed by BHEL/CUSTOMER.
- 26) Noise Max.85 db at 1 mtr. & 30⁰ C temp. rise at ambient. Witness for Noise & vibration measurement during the final inspection
- 27) HV at 2.5 KV AC for power ckt at 2 KV for control ckt, DOP by paper insertion method. BOI as per CUSTOMER Approved Makes. Will be Checked at the time of Final Inspection.
- 28) 7 Tank Pretreatment before Painting.
- 29) Crane Should be Operable by RRC & PPB (Radio Remote Controller, Pendent) meant for that Crane only.
- 30) Functional & Interlock test to be checked as per approved Electrical Schematic drawing.
- 31) Note for LT Motor:
- i) Motor rating up to 50 kw: inspection Cat- III : acceptance of motor up to 50 kw is based on COC of the manufacturer and main contractor confirming as follows: “It is hereby confirmed that the above-mentioned motor /motors was/ were manufactured taking care of customer specific requirements regarding ambient temp., voltage frequency variation, hot starts, pull out torque, kva/kw, temperature rise, distance between center of stud gland plate and tested in accordance with approved drawing /data sheets.”
- ii) Motor rating above 50 kw & less than 75 kw: inspection Cat- II as per customer approved MQP: acceptance of motor rating above 50 kw & less than 75 kw is based on Customer review of routine report as per is:12615 - 2018 (including latest revision) duly witnessed by main contractor along with COC of the manufacturer and main contractor confirming as follows: “It is hereby confirmed that the above-mentioned motor /motors was/ were manufactured taking care of Customer specific requirements regarding ambient temp., voltage frequency variation, hot starts, pull out torque, kva/kw, temperature rise, distance between center of stud gland plate, space heater and tested in accordance with approved drawing /data sheets.”
- iii) Motor rating 75 kw & above: inspection Cat-I: as per Customer approved MQP.
- 32) Safe working load test & 125% over load test shall be conducted at shop with actual hooks, vvfd panels, shop wire ropes & temporary cables. Load test at site shall be offered with all actual components including radio remote control tests and covered in field quality assurance plan.
- 33) All raw material shall confirm to BHEL approved drg. / ds / specification. i.e 100 % killed, normalized and ultrasonically tested quality (UT of plate thickness _ 25 mm).

LEGENDS:

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

** **M:** SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C:** BHEL/ THIRD PARTY INSPECTION AGENCY, **N:** END CLIENT,

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

MA: MAJOR, **MI:** MINOR, **CR:** CRITICAL. **H** - Hold point

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:			Checked by:			Page 16 of 152		Reviewed by:			
Reviewed by:			Reviewed by:					Approved by:			

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

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

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ VENDOR :		TITLE			NUMBER :			
		SHEET 3 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT * MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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

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

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
		SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-		(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE FOR MV MOTOR THREE DIPS TO BE GIVEN
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

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

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

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
									P	W	V
1	2	3	4	5	6	7	8	9	10		11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY											
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE					BIDDER'S/VENDORS COMPANY SEAL			

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

	QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER/ :			TITLE			NUMBER :			
	SHEET 2 OF 2		VENDOR			QUALITY PLAN			SPECIFICATION :			
		SYSTEM			NUMBER PED-506-00-Q-006, REV-01			TITLE :				
					ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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SUB VENDOR LIST

SR. NO.	ITEM	SUPPLIERS	REMARKS
1.	STEEL	SAIL	
		TISCO	
		JINDAL	
		RINL	
		ESSAR (AMNS)	
2.	HOOKS	STEEL FORGING & ENGG. CO.,	
		SIMRITI FORGING	
		IRIZAR FORGE, SPAIN	
		KARACHIWALA	UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE	
		FLEX-TRANS (formerly known as HICLIFF)	
		SAHARA	
		NUTECH	
		OEM	
4.	WIRE ROPE	USHA MARTIN	
		FORT WILLIAMS	
		B OMBAY WIRE ROPES	
		BHARAT WIRE ROPES	
5.	BEARINGS	SKF	
		FAG	
		TATA	
		NBC	
		ZKL	
		NORMA	
		NRB	
		NTN	
		KOYO	
		URB	

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6.	MOTORS	JYOTI LTD.	
		NGEF	(up to 15KW)
		CROMPTON	
		KEC	(UPTO 90KW)
		BHARAT BIJLI	
		MARATHON	
		ABB	
		HAVELLS	UPTO 90 KW
		LHP	
		BHARAT BIJLEE	
7.	BRAKES	ELECTROMAG	
		SPEED-O- CONTROL	
		BCH	FOR DCEM BRAKES ONLY
		KAKKU	
		PATHE	
8.	CONTACTOR	SIEMENS	
		L&T	
		SCHNEIDER (Earlier TELE MECHANIQUE)	
		ABB	
		GE-POWER	
		BCH	
9.	OVER LOAD RELAYS	SIEMENS	
		L&T	
		ABB	
		SCHNEIDER (Earlier TELE MACHANIQUE)	
10.	HRC FUSES	SIEMENS	
		L&T	
		ENGLISH ELECTRIC	
		GE POWER	
		EATON (BUSSMANN)	
		INDO ASIAN	
		C&S ELECTRIC LTD.	
		SPACEAGE SWITCHGEARS LTD.	
		ALSTOM LTD	
		ESSEN DEINKI	
		SCHNEIDER ELECTRIC INDIA PVT. LTD.	
		ABB	

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11.	ISOLATING SWITCH	SIEMENS	
		L&T	
		CONTROL & SWITCH GEAR	
		ABB	
12.	SWITCH FUSE UNITS	SIEMENS	
		L&T	
		SCHNEIDER	
		CONTROL & SWITCH GEAR	
13.	TIME DELAY RELAYS	ABB	
		BCH	
		SCHNEIDER (Earlier TELE MACHANIQUE)	
14.	TRANSFORMERS	INDCOIL	
		LOGICSTAT	
		KAPPA	
		AUTOMATIC ELECTRIC	
		PRECISE ELECTRICALS	
		SILKAAN ELECTRIC MFG. CO. LTD.	
		SOUTHERN ELECTRIC	
		UNILEC ENGINEERS PVT. LTD.	
15.	BULB & FLOURESCENT TUBES/FITTINGS	NEC	
		ANCHOR	
		PHILIPS	
		BAJAJ	
		Orient	
16.	CABLE LUGS (HEAVY DUTY)	CROMPTON	
		DOWELLS	
		UML ENGINEERS	
		CHETNA	
		BILLET	
17.	HOOTERS	BRACO	
		JAINSON	
		BEACON	
		OSC	
		TARGET	
		KHERAJ	

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18.	LIGHTING SWITCHES	ANCHOR	
		ELLORA	
		GE	
		CROPMTON	
		BAJAJ	
		PHILIPS	
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	
		CORDS CABLE INDUSTRIES LTD.	
		DIAMOND POWER INFRASTRUCTURE LTD	
		GOYOLENE FIBRES (INDIA) PVT.LTD	
		GOVIND CABLE INDUSTRIES	
		GUPTA POWER INFRASTRUCTURE LIMITED	
		HAVELLS INDIA LIMITED	
		KEI INDUSTRIES LTD.	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		MANSFIELD CABLES COMPANY LTD.	
		NICCO CORPORATION LTD.	
		PARAMOUNT COMMUNICATIONS LTD.	
		POLYCAB WIRES PVT. LTD.	
		RADIANT CORPORATION PRIVATE LIMITED	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD.	
		SRIRAM CABLES PVT. LTD.	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	
		SAM CABLES & CONDUCTORS (P) LTD	
		THERMO CABLES LTD	

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20.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	
		APAR INDUSTRIES LTD., CMI LTD	
		CMI LIMITED	
		CORDS CABLE INDUSTRIES LTD	
		CRYSTAL CABLE INDUSTRIES LTD	
		DELTON CABLES LTD	
		DIAMOND POWER INFRASTRUCTURE LTD	
		ELKAY TELELINKS LTD	
		GEMSCAB INDUSTRIES LTD	
		GOVIND CABLE INDUSTRIES	
		GUPTA POWER INFRASTRUCTURE LIMITED	
		HAVELLS INDIA LIMITED	
		INCOM CABLES (P) LTD	
		KEI INDUSTRIES LTD	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		MANSFIELD CABLES COMPANY LTD	
		NICCO CORPORATION LTD	
		PARAMOUNT COMMUNICATIONS LTD	
		POLYCAB WIRES PVT. LTD	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD	
		SPECIAL CABLES PVT. LTD	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	
		SAM CABLES & CONDUCTORS (P) LTD	
		SPM POWER & TELECOM PVT. LTD	
		TORRENT CABLES LTD	
		THERMO CABLES LTD	
		TIRUPATI PLASTOMATICS PVT. LTD	
		UNIVERSAL CABLES LTD	
21.	TRAILING CABLES	NICCO	
		UNIVERSAL	
		INCAB	
		ICL	
		APAR INDUSTRIES LTD	
		CMI LTD	
		KEI INDUSTRIES LTD	
		SUYOG ELECTRICALS LTD	

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22.	XLPE POWER CABLES	APAR INDUSTRIES LTD	
		CORDS CABLE INDUSTRIES LTD	
		CRYSTAL CABLE INDUSTRIES LTD	
		DIAMOND POWER INFRASTRUCTURE LTD	
		GEMSCAB INDUSTRIES LTD	
		GOVIND CABLE INDUSTRIES	
		GUPTA POWER INFRASTRUCTURE LIMITED	
		HAVELLS INDIA LIMITED	
		KEI INDUSTRIES LTD	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		MANSFIELD CABLES COMPANY LTD	
		PARAMOUNT COMMUNICATIONS LTD	
		POLYCAB WIRES PVT. LTD	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD	
		SPECIAL CABLES PVT. LTD	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	
		SRIRAM CABLES PVT. LTD	
		TORRENT CABLES LTD	
23.	XLPE CONTROL CABLES	THERMO CABLES LTD	
		TIRUPATI PLASTOMATICS PVT. LTD	
		APAR INDUSTRIES LTD	
		CABLE CORPORATION OF INDIA LTD	
		CRYSTAL CABLE INDUSTRIES LTD	
		DIAMOND POWER INFRASTRUCTURE LTD	
		GEMSCAB INDUSTRIES LTD	
		HAVELLS INDIA LIMITED	
		KEI INDUSTRIES LTD	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		PARAMOUNT COMMUNICATIONS LTD	
		POLYCAB WIRES PVT. LTD	
		RADIANT CORPORATION PRIVATE LIMITED	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD	
		SRIRAM CABLES PVT. LTD	
		TORRENT CABLES LTD	
		UNIVERSAL CABLES LTD	

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24.	CABLE GLAND	COMMET	
		SUNIL&CO	
		ARUP ENGINEERING	
		JAINSON	
		ELECTROMAC INDUSTRIES	
		INCAB	
		BALIGA LIGHTING EQPT.PVT.LTD	
		DOWELL	
25.	PUSH BUTTONS	SIEMENS	
		L&T	
		BCH	
		SCHNEIDER	
26.	LIMIT SWITCHES	SPEED-O-CONTROL	
		OMEGA	
		ELECTROMAG	
27.	MASTER CONTROLLER	SPEED-O-CONTROL	
		ELECTROMAG	
28.	SAFETY SWITCHES	ALSTOM	
		L&T	
		SCHNEIDER	
		ABB	
		SIEMENS	
29.	PENDENT PUSH BUTTON STATION	OEM	
30.	INDICATING LAMPS	TECKNIC	
		BCH	
		SIEMENS	
		STANDARD	
31.	MCB	MDS	
		INDO COPP	
		STANDARD	
		SIEMENS	
		L&T	
		ABB	
		S&S POWER SWITCHGEAR LTD,	
		SCHNEIDER	

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32.	PANELS	OEM	
		RITTAL	
		BCH	
		PYROTECH	
33.	RESISTANCE BOXES	ENAPROS	
		SOC	
		EMM	
		OEM	
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD.	
		ASHOKA ENGINEERING COMPANY	
		KANADIA FYR FYTER PVT. LTD	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
		NEW ENGINEERING CORPORATION	
		SAFEX FIRE SERVICES LTD	
		UNITED FIRE EQUIPMENTS PVT. LTD	
		ZENITH FIRE SERVICES (INDIA) PVT LTD	
		BIS APPROVED SOURCE WITH VALID LICENSE	
35.	VVVF	L&T -YASKAWA	
		ABB	
		SIEMENS	
		SCHNIEDER	
		FUJI ELECTRIC	
		ROCKWELL	
		VACON	
		mitsubishi electric	
36.	SHROUDED DSL	SUSHEEL	
		STROMAG	
37.	ANTI COLLISION DEVICE	SICK	
		IFM	
		ELECTRONIC SWITCHES INDIA	
38.	LOAD CELL	IPA	
		METTLER TOLEDO	
		SARTORIUS	
39.	RRC	ACROPOLIS ENGINEERING	
		HBC	
		SOC	
		SNT CONTROLS	

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40.	GEAR BOX	OEM	* = Applicable for Geared Motors only
		ELECON ENGINEERS	
		SHANTI GEARS	
		PBL*	
		NAW*	
		NORD*	
		SEW*	
41.	RAIL	BONGFILIOLI*	
		JSPL	
		SAIL	
42	CENTRALIZED LUBRICATION / HYDRAULIC POWER PACK	LUBCON, PUNE	CRANE OEM MAKE POWERPACK IS NOT ALLOWED.
		PRAKASH LUBRICANT, KOLKATA	
		AFMC, KOLKATA	
		SKF ENGG AND LUBRICATION (LINCOLN HELIOS)	
		VIJAY ENGINEERS	
		INDO HYDRAULIC BOMBAY PVT LTD	
		MEHATA HYDRAULIC EQUIPMENT	
		CLAYSYS	
		VEDNAT ENGINEERING SERVICES	
43	MCCB/MPCB	ELECTROPNEUMATICS AND HYDRAULIC PVT LTD	
		SN HYDRAULIC	
		L&T	
		ABB	
44	SINGLE PHASE PREVENTOR	SIEMENS	
		SCHNIEDER	
		MINILEC	
45	Drag Chain	L&T	
		SIEMENS	
		IGUS/Reputed make	

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46	CONTROL SWITCHES/ SELECTOR SWITCH	KAYCEE	
		GE-POWER	
		ALSTOM LTD	
		SCHNEIDER ELECTRIC INDIA PVT. LTD.	
		M/s Shrenik & Co.	
		RECOM PVT. LTD.	
	Note:		
1	THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND DVC APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL		
2	BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.		
3	THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ DVC.		



**TECHNICAL SPECIFICATION
NLC TALABIRA (3X800 MW PHASE-1)
DOUBLE GIRDER EOT CRANES
FOR TG HALL**

PE-TS-511-501-A501

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PAINTING REQUIREMENT

Package	Condition	Surface Preparation	Paint	Primer		Intermediate			Final			Total DFT
				No. of Coats	DFT (in Microns)	Paint	No. of Coats	DFT (in Microns)	Paint	No. of Coats	DFT (in Microns)	
DOUBLE GIRDER EOT CRANE	Structure	Sa 2.5	HB Zn Phosphate	2	40 micron per coat	HB MIO epoxy	1	120 microns	Poly urethane	2	30 micron per coat	260 microns
	Hand rails, Chequered plates,	Sa 2.5	Hot dip galvanizing									610 gm/sq.m
	Panels	Seven tank process	Powder coated									70-80 micron

COLOR SHADE

SL. No	Item Description	Color Shade	Remarks
1	Crane structure, Crane girders, Hoist block, Trolley	Golden Yellow shade 356 as per IS-5	Black Letters
2	Hooks	Crimson shade 540 as per IS-5	White Letters
3	Motors	Light grey shade 631 as per IS-5	

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PACKING REQUIREMENT	
	COMMON GUIDELINES FOR PACKING
1	GENERAL:
1.1	The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.
1.2	All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.
1.3	The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.
1.4	Each package shall be accompanied by a packing note quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

2.	TYPES OF PACKING:
	The following 5 types of packing have been standardized for packing of General Components/ Assemblies.
a	OP' - Open Type.
b	PP' - Partially Packed.
c	CP' - Crate/Box Packing - Components/Equipment requiring physical protection.
d	'CQ' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
e	'CR' - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc...

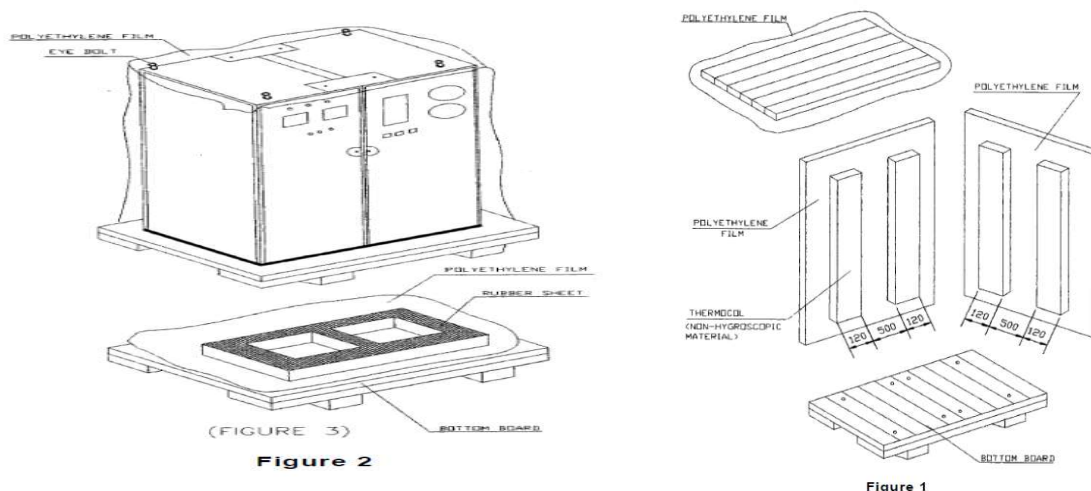
3.	DESCRIPTION OF TYPES OF PACKING:
	The various types of packing, as standardized above, are described below.
3.1	'OP' - Open Type
	In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.
3.2	PP' - Partially Packed
3.2.1	Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene
3.2.2	Film. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film.
3.3	'CP' - Crate Packing
	Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.
3.4	'CQ' - Case Packing - Machined Components/Assemblies/Equipment
3.4.1	Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.
3.4.2	For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.
3.5	CR' - Case Packing - Electrical & Electronic Components/Assemblies
	Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel.

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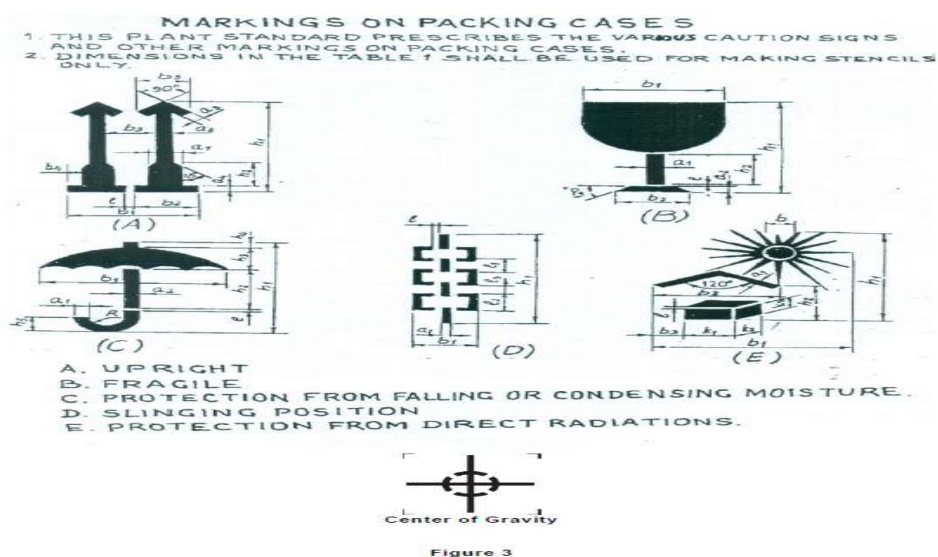
4	PREPARATION OF PACKING CASES
4.1	DIMENSIONS:
a)	Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units/manufacturers.
b)	Width of all planks including the tongue shall be more than 125mm and after planing it shall be minimum 100mm.
c)	Minimum number of planks shall be used for a shook.
d)	Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel).
e)	Width of binding planks shall be minimum 100mm.
f)	Distance between any 2 binding planks shall be less than 750mm.
g)	diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm
h)	Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
i)	Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.
4.2	HOOP IRON STRIPS
	These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.
4.3	BRACKETS
	These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.
4.4	MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM
	100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.
4.5	RUBBERISED COIR:
	The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.
5	MULTI LAYER CROSS LAMINATED POLY FILM WHILE PACKING OF CUBICLES/CASING
5.1	The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.4) using blue nails wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.
5.2	The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film. This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.
5.3	The cubicles shall be covered with Multi-layer cross laminated poly film.
6	PACKING OF LOOSE ITEMS/SPARES
6.1	Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 5.4) using blue nails.
6.2	Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
6.3	Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.
6.4	Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
6.5	Silica gel held in cotton bags shall be kept at proper places in the box.
6.6	Packing slip kept in polyethylene bag shall be placed in the box.
6.7	Two numbers of hoop iron strips shall be strapped tightly on the case using clips.
6.8	Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
6.9	Loose items to be kept inside the cubicle/casing
	- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

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7	TYPICAL PATTERN OF WOODEN BOX
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8	SEALED PACKING:
	Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and
9	MARKINGS/STENCILINGS
9.1	"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".
9.2	Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.
9.3	In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel.
9.4	Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.
9.5	Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.
9.6	In case the size of package is small for using the stencils, then hand written letters/figures shall be allowed.



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BHEL – <unit> - <location> - <pin>	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO	CASE NO
DIMENSIONS(MM) L x B x H	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT



Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

10 STANDARD METHOD OF PACKING

Table 1 - Standard Method of Packing

S. No.	DESCRIPTION	CASE	CRATE	BUNDLE	BARE	DRUM
1	FAB STRUCTURALS, GIRDER				O	
2	FAB STRUCTURALS, GIRDER				O	
3	SUPPORTING STRUCTURALS				O	
4	STRUCTURE SUB ASSEMBLY, CRAB, END CARRIAGE, END STOPPERS, ROPE DRUM				O	
5	RAIL				O	
6	STAIR CASES				O	
7	HANDRAILS/ PLATFORMS/ LADDERS/ CAGE				O	
8	FASTENERS, RAIL CLAMPS AND FIXING ACCESSORIES	O				
9	BEARING BLOCKS	O				
10	FANS	O				
11	GASKETS	O	O			
12	FLANGES	O	O			
13	PAINT TINS		O			
14	PAINT DRUMS					O
15	MOTORS, TRANSFORMERS, VVFD, LIMIT SWITCHES, ELECTRIC HOIST ASSEMBLY, RELAYS, FUSES, LIGHTING FIXTURES, PENDANT, ISOLATING SWITCH, RRC, TRANSMITTERS AND OTHER ELECTRICAL ACCESORIES	O				
16	SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES, PANELS,		O			
17	INDICATORS, VIBRATOR SWITCHES	O				
18	CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL,		O			
19	OPERATIONAL SPARES , MAINTENANCE TOOLS AND TACKLES	O				
20	ALL OTHER LOOSE ITEMS	O				

Note

1	Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.
2	Case, crate for all small items, electrical items, loose items are to be dispatched in containers. Containers shall become property of BHEL.



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BILL OF QUANTITY

A	SUPPLY:							
	S. No.	Description	For 150/30T Double Girder Crane 1		For 150/30T Double Girder Crane 2		Common for both Double Girder cranes	
			Qty	UOM	Qty	UOM	Qty	UOM
	1	Bridge girders along with walkway, platform, handrails, CT stoppers etc.	2	Nos.	2	Nos.	----	----
	2	End carriages						
	a	End carriages structure with walkway, platform, handrails, LT buffers etc.	1	set	1	set	----	----
	b	Long Travel Mechanism (Motor, gear box, shaft couling, wheels, brakes, bearings etc.)	1	set	1	set	----	----
	3	Crab (trolley)						
	a.	Crab (trolley) structure with CT rails, platform, handrails, CT buffers etc.	1	set	1	set	----	----
	b	Main Hoist Mechanism (Motor, Gear box, Rope drum, Rope Upper block, Lower block, hook, couplings, shaft, brakes, bearings etc.)	1	set	1	set	----	----
	c.	Aux Hoist Mechanism (Motor, Gear box, Rope drum, Rope Upper block, Lower block, hook, couplings, shaft, bearings, brakes etc.)	1	set	1	set	----	----
	d.	Cross Travel Mechanism (Motor, gear box, shaft couling, wheels, brakes, bearings etc.)	1	set	1	set	----	----
	4	LT End stopper	4	Nos.	4	Nos.	----	----
	5	Storm Brake	2	Nos.	2	Nos.	----	----
	6	LT rail along with accessories.	----	----	----	----	Baylength	m
	7	LT PVC insulated shrouded bus bar conductor type DSL with accessories and junction boxes as required	----	----	----	----	Baylength	m
	8	Operator's cabin along with operator's seat, gong, fan and other acesories	1	set	1	set	----	----
	9	Main hoist limit switch (Rotory gar + Gravity)	1+1	Nos.	1+1	Nos.	----	----
	10	Aux hoist limit switch (Rotory gar + Gravity)	1+1	Nos.	1+1	Nos.	----	----
	11	CT lever type limit switch (one way/two way)	2/1	Nos./No.	2/1	Nos./No.	----	----
	12	LT lever type limit switch (one way/two way)	2/1	Nos./No.	2/1	Nos./No.	----	----
	13	Power cables, control cables etc. along with cable tray/conduits etc.	1	set	1	set	----	----
	14	Temprrory cable: 3.5 Core Power copper flexible cable of suitable size as per load calculation for commissioning, testing & operation of EOT Crane till such time the DSL is charged.	250	m	250	m	----	----
	15	Main Isolating switch cum Changeover	----	----	----	----	1	No.
	16	Protective Panel along with Control transformers, lighting transformers, 415/24 V (DC) transformer, contactors, switches, fuses relays and other accessories	1	No.	1	No.	----	----
	17	Main Hoist Panel along with VVFD, contactors, switches, fuses relays and other accessories	1	No.	1	No.	----	----
	18	Aux Hoist Panel along with VVFD, contactors, switches, fuses relays and other accessories	1	No.	1	No.	----	----
	19	Cross Travel Panel along with VVFD, contactors, switches, fuses relays and other accessories	1	No.	1	No.	----	----
	20	Long Travel Panel along with VVFD, contactors, switches, fuses relays and other accessories	1	No.	1	No.	----	----
	21	Master Controller	1	No.	1	No.	----	----
	22	Lighting for cranes (including illumination in cabin, over bridge and under bridge) along with fittings, sockets etc.	1	set	1	set	----	----
	23	Portable 40 W hand lamp with minimum 14.5 m length flexible cable for inspection	1	set	1	set	----	----
	24	Fire extinguisher	4	Nos.	4	Nos.	----	----
	25	Maintenance cage	1	No.	1	No.	----	----
	26	Mechanical overload protection (Load cell) for main hoist and aux hoist mode with digital display	1	No.	1	No.	----	----
	27	Radio Remote control with transmitter unit, receiver unit, battery etc.	1	set	1	set	1	set
	28	Isolating switches for maintenance of cranes	1	No.	1	No.	----	----
	29	Lifting beam & its slings	----	----	----	----	----	----
	30	Anti collision device	1	No.	1	No.	----	----

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	31	Centralized grease lubrication system to be provided with hand pumps located at crab and both end carriages for all grease lubricated bearings of crane.	1	set	1	set	----
	32	DSL Phase indicating lamps (RYB)	----	----	----	----	4 Sets
	33	Earthing strips	1	set	1	set	----
	34	First fill of lubricants i.e. oils, grease, servo fluids, cadmium compounds etc.	1	set	1	set	----
	35	E-Learning Package	----	----	----	----	----
	36	Slings for load/overload testing of EOT cranes & lifting beam in tandem (if applicable) operation at site .	----	----	----	----	1 set
	37	Maintenance tools & tackles					
	a.	Complete set of ring spanners	----	----	----	----	1 set
	b.	Complete set of screwdrivers (Min. 6 Nos., Indicate the sizes)	----	----	----	----	1 set
	c.	Adjustable Spanner	----	----	----	----	1 no.
	d.	Insulated plier	----	----	----	----	1 no.
	e.	Wrench spanner	----	----	----	----	1 no.
	f.	Grease Gun	----	----	----	----	1 no.
	g.	Oil Gun.	----	----	----	----	1 no.
	h.	Hand Lamp.	----	----	----	----	1 no.
	i.	Line tester	----	----	----	----	1 no.
	j.	O&M Manual	----	----	----	----	1 no.
	k.	Steel box to place above tools & manual	----	----	----	----	1 no.
	41	Erection & Commissioning Spares	----	----	----	----	
	a.	Oil seal for each gear box	2	nos.	2	nos.	----
	b.	Indicating lamps of each color	2	nos.	2	nos.	----
	c.	Push button of each type and rating	2	nos.	2	nos.	----
	d.	Auxiliary Contactor of each rating	2	nos.	2	nos.	----
	e.	Limit switches	2	nos.	2	nos.	----
	f.	HRC Fuses of each size	1	no.	1	no.	----
	g.	Touch up paints	10	Ltr.	10	Ltr.	----
	42	Any other item/s for completion of scope of work	----	----	----	----	1 set
	43	Operation and maintenance Spares					
	a.	Gear Oil in sealed packets/containers.	----	----	----	----	40 litres
	b.	Grease in sealed packets/containers.	----	----	----	----	40 kg
	c.	Brake Oil in sealed packets/containers.	----	----	----	----	240 litres
	d.	Cardium compounds in sealed packets/containers.	----	----	----	----	60 kg
	e.	Brake shoes	----	----	----	----	2 Set
	f.	Brake liners	----	----	----	----	2 Set
	g.	Brake springs	----	----	----	----	2 Set
	h.	Oil seal for gear box	----	----	----	----	2 Set
	i.	Main & auxilliary contactors of each type and rating	----	----	----	----	1 Set
	j.	Overload relays of each rating	----	----	----	----	1 Set
	k.	Bearing for motors of each size and rating	----	----	----	----	2 Set
	m.	Limit switch of each type and rating	----	----	----	----	2 Set
	n.	Push button of each type and rating	----	----	----	----	1 Set
	o.	Panel lights, indicating lamps etc	----	----	----	----	1 Set
	p.	Main Isolating switch cum Changeover with box and lever	----	----	----	----	1 no.
	q.	Fuse of each type and rating	----	----	----	----	1 Set
	r.	MCB/MCCB of each type and rating	----	----	----	----	1 Set
	s.	Under bridge and over bridge lights of each type and rating	----	----	----	----	1 Set
	t.	Tags for cables, panels, JB's etc.	----	----	----	----	1 Set
	u.	Master Controllers for all motions	----	----	----	----	1 Set
	v.	Accessories i.e Rail clamps , alignments blocks, washers , springs , bolts etc. for rail fixing.	----	----	----	----	For approximately 3% of total rail length
	Note for Operation and maintenance Spares:-						
	1	Operation and maintenance spares shall be supplied in separate box/container clearly marked " O & M spares" with individual Machined Components/Assemblies/Equipment, Electrical & Electronic Components/Assemblies protected as per the packing defined in "Packing Requirement" of this specification.					
	2	Grease,lubricants,oils,compounds etc shall be supplied is such size of packets/containers so that they are opened and utilized in one application/use.					
	3	One (1) Set is defined as 100% requirement for one crane.					

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	4	Operation and maintenance spares shall be used for general/breakdown maintenance during operation and also during periodic healthiness check services (to be provided by crane vendor). Unused Operation & Maintenance spares, as available, during closure of punch point to facilitate handing over of cranes shall be issued by BHEL to the bidder. However bidder at their own discretion may also envisage suitable spares or additional quantity that may be required to facilitate handing over.						
B	MANDATORY SPARES:							
	S. NO.	ITEM DESCRIPTION	Qty	UOM	Qty	UOM	Qty	UOM
		AS PER ANNEXURE-III of PRICE FORMAT						
		Following notes shall be applicable for mandatory spares						
	i	The bidder shall give itemized unit price for the spare parts, tools and tackles while submitting the Bid. The Owner reserves the right to modify or delete the items/quantity of the spares/tools & tackles. The quoted price for taxes & duties, transport, insurance etc shall get reduced proportionately to the extent of the value of ordered spares/tools and tackles. The list of such spares/tools and tackles to be ordered by the Owner shall be finalized by the Owner before signing of the Contract.						
	ii	In case if such items of spares/tools & tackles indicated as "not applicable", are found applicable at a later date during execution of the project, such items of spares/tools & tackles are to be supplied within the ordered, cost or the mandatory spares.						
	iii	If any of the items of spares/tools & tackles ordered is found to be not applicable during detailed engineering stage/execution stage, the Contractor shall have to supply alternative items of spares/tools & tackles. The alternative items of spares/tools & tackles are to be mutually agreed between the Owner and Contractor.						
	iv	In respect of quantity, mentipned las, :Set' means. the jotal quantity of all the components/items used in particular equipment unless otherwise specified.						
	v	All relevant drawings & schedules to identify spares/tools & tackles are to be furnished when called for by the Owner.						
	vi	Spare parts for equipment shall be of the same make and be interchangeable with the original components.						
C	SERVICES			For Double Girder Crane 1		For Double Girder Crane 2		Common for both Double Girder cranes
	S.N.	Description	Qty	UOM	Qty	UOM	Qty	UOM
	A	Visits						
	1	Visits for Supervision of Unloading activitiy					2	Visits
	2	Visits for Supervision of Erection & Comissioning					4	Visits
	3	Visits for Supervision of load testing activity					2	Visits
	4	Visits for Supervision of tandem operation (As applicable)					--	Visits
	B	Supervision in Days						
	1	No. of days of stay at site during Supervision of Unloading activitiy					4	days
	2	No. of days of stay at site during Supervision of Erection & Commissioning					120	days
	3	No. of days of stay at site during Supervision of load testing activity.					8	days
	4	No. of days of stay at site during Supervision of tandem operation.					--	days
	C	Healthiness check service						
	1	Total no. of visits for period of 3 years at site for healthiness checks (quarterly)					12	Visits
	2	Total no. of days of stay at site for healthiness checks for period of 3 years					48	days

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DOCUMENTATION REQUIREMENT

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY ALL THE BIDDERS ALONG WITH THE BID

Sl. No.	DOCUMENT TITLE
1	PQR CREDENTIALS
2	COMPLIANCE CERTIFICATE
3	"NO DEVIATION" CERTIFICATE DULY STAMPED AND SIGNED.
4	CRANE CLEARANCE DIAGRAM OF TG HALL EOT CRANES DULY STAMPED AND SIGNED.

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT ALONG WITH SUBMISSION SCHEDULE				
A	BASIC ENGINEERING DRAWING / DOCUMENTS			
S.N.	BHEL drawing No.	Title	Approval category	Schedule date of submission (with in given weeks from date of LOA)
A	BASIC ENGINEERING DRAWING / DOCUMENTS			
1	PE-V0-511-501-A201	Manufacturing Quality Plan with sub vendor list For TG Hall Crane	A	3
2	PE-V0-511-501-A204	SIZING CALC FOR ROPES, WHEELS, DRUM,BUFFERS, BRAKES & MOTORS OF TG HALL EOT CRANE	A	3
3	PE-V0-511-501-A205	GA OF TG HALL EOT CRANE & Lifting Beam GAD	A	3
4	PE-V0-511-501-A212	Structural calculations For TG Hall Crane (including structural calculation for crab structure)	A	4
5	PE-V0-511-501-A217	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Aux. hoist panel & BOM d) Cross Traverse & BOM e) Long Traverse & BOM Including earthing diagram For TG Hall Crane"	A	5
B	BALANCE ENGINEERING DRAWING / DOCUMENTS			
1	PE-V0-511-501-A228	DATA SHEET FOR MOTORS-TG HALL EOT CRANE	I	6
2	PE-V0-511-501-A206	CRAB ASSEMBLY WITH CT WHEEL ASSEMBLY-TG HALL CRANE	I	3
3	PE-V0-511-501-A208	General arrangement for PVC shrouded DSL for TG Hall crane	I	3
4	PE-V0-511-501-A211	HOOK, NUT AND HOOK BLOCK ASSEMBLY OF MH & AH OF TG HALL EOT CRANE	I	3
5	PE-V0-511-501-A210	LT MACHINERY ASSEMBLY WITH WHEEL ASSEMBLY OF TG HALL EOT CRANE	I	4
6	PE-V0-511-501-A211	SIZING CALCULATION OF LIFTING BEAM & LIFTING BEAM ASSEMBLY DRAWING OF TG HALL EOT CRANE	A	3

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7	PE-V0-511-501-A216	Electrical equipment layout in cabin for TG Hall crane	I	6
8	PE-V0-511-501-A218	"General Arrangement of a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Travel panel e) Long Traverse travel panel. f) Pendent g) Remote Radio Control For TG Hall Crane"	I	5
9	PE-V0-511-501-A220	DSL VOLTAGE DROP & CABLE SIZE CALCULATION OF TG HALL EOT CRANE	A	6
10	PE-V0-511-501-A221	Type test certificate (for motors) For TG Hall Crane (Applicable for above 100 KW rating motors)	A	10
11	PE-V0-511-501-A226	MANUFACTURING QUALITY PLAN FOR LIFTING BEAM FOR TG HALL EOT CRANES	A	3
12	PE-V0-511-501-A227	DATA SHEET OF TG HALL EOT CRANE	A	8
13	PE-V0-511-501-A232	GANTRY RAIL FIXING ARRANGEMENT OF TG HALL EOT CRANE	I	4
14	PE-V0-511-501-A250	CRANE LUBRICATION ARRANGEMENT OF TG HALL CRANES	I	6
15	PE-V0-511-501-A203	MANUFACTURING QUALITY PLAN OF MOTORS (ABOVE 50 KW) FOR TG HALL EOT CRANE	A	6
C Bidder to submit following additional document also.				
1	PE-V0-511-501-A220	Crane Operational write up For TG Hall Crane	I	5
2	PE-V0-511-501-A223	Mandatory spare parts list For TG Hall Crane (if applicable)	A	16
3	PE-V0-511-501-A225	Unloading & Erection procedure For TG Hall Crane	I	16
4	PE-V0-511-501-A214	O&M MANUAL OF TG HALL EOT CRANE	I	12
5	PE-V0-511-501-A551	Cradle calculation & drawing/s for fabrication.	I	14
6	PE-V0-511-501-A553	Consignment details (including details of dimensions (LxBxM), weight, type i.e. loose/box/crate)	I	10
7	PE-V0-511-501-A560	Field Quality Plan	I	20
8	PE-V0-511-501-A511	Any other documents if required during detail engineering	-	-
LEGENDS				
A= Approval category				
I= Information category				

Notes:-

1	Bidder to follow the following the drawing submission schedule: i. 1st submission of drawings from date of LOI as per the submission schedule. ii. Every revised submission incorporating comments – within 10 days. iii. BHEL & Customer Comment/ Approval -18 days
2	Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

DRAWINGS & DOCUMENTS TO BE SUBMITTED AS FINAL/AS-BUILT DOCUMENT			
Sl. No.	DOCUMENT TITLE	No. of prints (Sets)	No. of portable hard
1	APPROVED DOCUMENTS	3	2

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2	AS BUILT DRAWINGS/ DOCUMENTS	3	2
3	ERECTION MANUAL	3	2
4	O&M MANUAL	3	2
5	PERFORMANCE AND FURNTIONAL GUARANTEE TEST REPORTS	3	0

ELECTRICAL LOAD DATA FORMAT (TO BE PROVIDED BY BIDDER DURING DETAIL ENGINEERING)

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

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.		ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE		NAME		DATA FILLED UP ON	
		SYSTEM / S	DG EOT CRANE	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

SCOPE MATRIX FOR ELECTRICAL PART

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	BHEL	BHEL will provide two number 415 V AC (3 PHASE 3 WIRE) supply feeder only up to isolating switch for each crane. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	BHEL	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	BHEL	
4	Equipment Earthing	Vendor	BHEL	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	BHEL	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty lugs for power & control cables.

	TECHNICAL SPECIFICATION NLC TALABIRA (3X800 MW PHASE-1) DOUBLE GIRDER EOT CRANES FOR TG HALL	PE-TS-511-501-A501 Rev. No. 00 Date : Jun 2026
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COMPLIANCE CERTIFICATE

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

1	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.
2	Bidder shall submit Manufacturing Quality Plan(MQP) in the event of order based on the guidelines given in the specification & reference MQP enclosed therein. MQP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing and additional inspection requirement, if any shall be marked in the MQP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
3	All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
4	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.
5	All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
6	Guarantee for plant/ equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions.
7	In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account.
8	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.
9	As built drawings shall be submitted as and when required during the project execution.
10	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.
11	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.
12	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.

Signature of authorised Representative

Name and Designation :

Name & Address of the Bidder

Date