

Memorandum of Understanding

**M/s BHEL
Trichy – 620 014**

and

**M/s. XXXXXXXXXXXXXXXXXXXX.
XXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXX
XXXXXXXXXX**

(Vendor Code : XXXXX)

For supplying

Electrically Operated Handling Equipment

**MOU NO : MOU / TPBHEL / HOIST- Rev.04
Date : 30-06-2018**

Engineering

Quality

Purchase

Vendor

**Memorandum of Understanding (MOU) between BHEL / FB and M/s. xxxxxxxxxxxxxxxx,
for supplying Electrically operated Handling Equipments.**

1.0 GENERAL:

- 1.1 This MOU is signed for supplying the Hoists as per the agreed standardized specification so that these details need not be discussed again and again for future supplies.
- 1.2 The various aspects covered in this MOU are as follows.
 - 1.2.1 The general points are covered in Section – 1.0 – General.
 - 1.2.2 The specification requirements are covered in Section – 2.0 – Specifications.
 - 1.2.3 The documents to be submitted along with the offer / after placement of Order / along with the hoists are covered in Section 3.0.
 - 1.2.4 The Inspection / Testing and Packing requirements are covered in Section – 4.0 Testing, Inspection and Packing.
 - 1.2.5 The project specific details / data and if any customer specific requirements shall be covered in Section 5.0 – Project related Information. **DEVIATION ON PROJECT RELATED INFORMATION WILL LEAD TO REJECTION OF OFFER.**
 - 1.2.6 **If any differences are found between the details given in Section 5.0 and other sections, Section 5.0 shall be considered as final and the vendors shall meet this requirement for that particular project.**
- 1.3 Sections 1.0, 2.0, 3.0 and 4.0 are standard and Section 5.0 alone will be furnished along with enquiry to the vendors for their acceptance.
- 1.4 **It is agreed that no deviations will be taken by the vendors while submitting their offers against future enquiries.**
- 1.5 Since the specifications are standardized and an understanding has been reached, the future enquiries will be floated on “SINGLE BID SYSTEM” only. Hence, if any offer is found with deviations, the same will be totally rejected and will not be considered for further evaluation.
- 1.6 Pre commissioning spares (if applicable) with price break up as per the list (vide Section 5.0) shall be supplied along with the hoists.
- 1.7 Two years recommended Spares list(vide Section 5.0) with price break up shall be enclosed.
- 1.8 If any special or non-standard tools are required for installation, operation or maintenance, the same shall be supplied along with the hoists.
- 1.9 Trouble-free operation of the equipment shall be guaranteed for a period of 18 months from the date of commissioning OR 24 months from the date of dispatch whichever is earlier.
- 1.10 Vendor has to provide Bank Guarantee for 10% order value (as per BHEL format) valid

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for a period mentioned in point No.1.10.

- 1.11 Dispatch clearance will be issued along with PGMA with DU Nos. for the ordered items to vendor after the receipt of acceptable Inspection Report. Vendor agreed to mark the PGMA with DU Nos. in the casing of the packing and in the Packing Slip.
- 1.12 Materials shall be dispatched on “Door Delivery with or without Consignee Copy attached basis to avoid demurrage at transporter’s go down”.
- 1.13 Since the vendors works alone is approved by BHEL, it is agreed the vendor will manufacture this item in their own works only and will not off-load the jobs to any other suppliers without the written approval by BHEL.
- 1.14 All components of the hoists should be packed in such a way that it should not get damaged during transport.
- 1.15 BHEL and the Vendor shall have an involvement which will commence at bid stage and follow through the completion and acceptance, thus ensuring total conformity to Purchaser’s requirements.

2.0 SPECIFICATIONS

2.1 Scope

This specification covers design, manufacture, inspection, testing and supply of electrically operated Under Hung Crane (UHC), Trolley With Hoist (TWH), and Down Shop Leads (DSL) . Technical parameters for equipment design are furnished in Section-1 to 4. For scope of supply and special requirements refer to Section-5.

This is a general specification dealing with technical requirements of various handling equipment as specified under scope. Contract requirements and special requirements (if any) for a particular project are specified in Section5.

2.2 Codes & Standards:

In addition to the following latest revisions of codes and standards, the equipment shall be designed to meet the other governing standards as applicable and also meet with the local standards where the equipment is installed.

IS 3938	...	Electric wire rope hoists.
IS 807	...	Design, Erection and testing (structural portion) of cranes and hoists code of practice.
IS 2758	...	Mild steel point hooks for use with wire rope thimbles.
IS 15560	...	Point hooks with shank upto 160 tonne -specification
IS 2266	...	Steel wire rope for general engineering purpose.
IS 2365	...	Specn for Steel Wire Suspension Ropes for Lifts, Elevators and Hoists
IS 3681	...	Gears-cylindrical gears-accuracies.
IS 325	...	Three-phase induction motors.
IS 1554 Part 1	...	Insulated cables for working voltage upto and including 1100V.
IS 4691	...	Degrees of protection provided by enclosures for rotating electrical machinery.
IS 2062	...	Hot rolled low, medium and high tensile structural steel.
IS 816	...	Code of practice for use of metal arc welding for general construction in mild steel.
IS 2074	...	Ready mixed paint air drying red oxide-zinc chrome, priming.
IS 2932	...	Enamel synthetic, exterior (a) under coating, (b) finishing.
IS 3177	...	Code of practice for electric over head traveling crane and gantry crane other than steel work cranes.
IS 13947 (Part I)	...	Specification for low-voltage switchgear & control gear
IS 1024	...	Code of practice for use of welding in bridges and structures subject to dynamic loading.

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IS 1875	...	Carbon steel Billets, Blooms, Slabs and Bars for Forgings.
IS 1835	...	Specification for Round Steel wires for ropes..
IS 9968	...	Elastomer insulated cables:part 1 for working voltages upto and including 1100V.
(Part-1)		

2.3 Design & Constructional Requirements:

Construction of TWH, UHC and DSL shall be of consistent capacity, lift, head room, span, over hang and any other parameters as specified in Annexure- I of Section-5.

2.4 Electrically operated Under Hung Crane & Trolley With Hoist:

All equipments shall be designed for OUTDOOR application and suitable for ambient temperature range of 0 to 50°C. Purchaser will provide electric power supply at one or more points near to the monorail / runways as required in the plant layout. Service class to be considered for design of trolley with hoist and under hung crane shall be as per class 2 of IS 3938 and IS 3177 / IS 807 respectively. All material used for construction of different components shall individually conform to applicable standard. All welds shall conform to IS 1024 and welders shall be qualified to AWS D1.1 / ASME Section IX.

Trolley with hoists and Under Hung Cranes shall be provided with protective hood and hard rubber sweepers.

2.4.1 Hooks:

- 2.4.1.1 Hooks shall meet the dimensional, material testing & inspection requirement of IS 15560.
- 2.4.1.2 The hook shall be provided with standard depress type safety latch and swivel thrust bearings with hardened race.
- 2.4.1.3 Lugs for fixing safety latch shall be either forged along with the hook or clamp type latch with lugs shall be provided.
- 2.4.1.4 Welding of lugs not permitted.
- 2.4.1.5 Locking arrangement shall be provided to avoid unscrewing of the hook in service.
- 2.4.1.6 Material of hook shall conform to IS-1875 or equivalent (with minimum tensile strength 50-62 Kg/mm².) and made by controlled grain forging and normalized.
- 2.4.1.7 Proof load tests for all the hooks shall be tested as per IS 15560 (i.e. for lifting capacity upto 32T, proof load shall be two times the lifting capacity. For lifting capacity 40T to 50T, proof load shall be 1.7 times the lifting capacity). All hooks shall be examined by MPI / LPI & UT (UT required for hooks >5.0T capacity) for cracks after proof load test.
- 2.4.1.8 The hook shall not distort or fracture. Ball & roller bearings shall not be used in these hooks. Anti-friction thrust bearings shall be used.

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2.4.2 Wire Ropes:

Wire ropes shall meet the requirement of IS 2266 / IS 2365. Shall have six strands of 37/36 wires per strand with an ultimate tensile strength of 180 Kg/mm². The wire rope shall be galvanized, as per IS 1835 type B. All wire ropes shall be proof load tested for 2 times of SWL/Fall. Breaking load shall not be less than five times SWL/Fall. Indicating the breaking force of wire rope, test certificate provided by the wire rope manufacturer for breaking load test shall be furnished during inspection. The rope shall be of sufficient length to retain two full wraps on the drum at lowest hook position.

2.4.3 Drum & Sheave:

Drum shall be of welded steel or seamless steel and Sheave shall be of cast or welded steel. The drum shall accommodate all the length of rope required for the lift plus two dead wraps at each anchor point without overlap. Drum can be grooved right or left or both, and grooves shall suit the ropes used. Sheaves shall be equipped with sheave guards to retain the rope in groove.

2.4.4 Gears & Pinions:

Material of construction shall be conforming to relevant Indian Standard (IS:3681) / (BS 970) or equivalent and shall be hardened if required to achieve the specified hardness. Hardness for Cross Travel & Long Travel (CT & LT) shall be in the range of 250 to 290 BHN for pinions and 215 to 255 BHN for gears. Hardness for hoisting shall be in the range of 285 to 300 BHN for pinions & 250 to 265 BHN for gears. In case of case hardened gears and pinions, a max. hardness of 350 BHN for gears and 390 BHN for pinions is acceptable. However, vendor shall maintain and ensure that gear hardness is always less than pinion hardness by at least 35 BHN. Helical/Spur gears shall be used for hoists, CT & LT. All gears and pinions shall be examined by LPI/MPI for surface cracks after hardening. In case of enclosed gearing, means shall be provided for ample lubrication. Such lubrication points are to be indicated in the drawing. The vendor shall specify the specification of lubricant, market trade names, quantity of lubricant requirement and frequency of lubrication.

2.4.5 Wheels:

Shall be made out of forged or low carbon steel/cast steel with heat treated to 175 to 200 BHN hardness. The drive gears, if any, integral with the wheel shall be of the same material and hardness. Trolley wheels for hoists shall be spur geared type, cast / forged 4 wheeled out of which 2 wheels shall be driven by motor.

2.4.6 Rotating & Stationary shafts:

The material for shafts shall be as per relevant Indian standard or its equivalent and shall be hardened and tempered with a minimum tensile strength of 60 Kg/mm² and hardness shall be maximum 175 to 250 BHN. UT test shall be done for all Shafts of diameter more than 50mm. UT acceptance norms shall be as per ASME section VIII; Division 2.

2.4.7 Bearings:

Shall be reputed make (FAG/SKF/TATA/NBC) and shall meet relevant IS standards. All bearings shall be designed to give a minimum service life of 20 years.

2.4.8 Brakes:

Hoisting, cross travel and long travel shall be provided with electro- mechanical friction shoe type brake or Disc type brakes or Electromagnetic disc type brake or Electro hydraulic thruster brake. The brakes shall be released with electric power and fail-safe in case of power failure. All brakes shall, irrespective of controller portion, be applied immediately on operating an emergency push button or switch. It shall be possible to arrest the load at any desired location with minimum slip. Slip with reference to speed shall be specified along with the offer. Brakes shall be designed as per the latest edition of IS:3938 / International standards.

2.4.9 Trolley:

Shall be of minimum 4 wheeled out of which 2 wheels should be spur geared type and fabricated construction. Trolley shall be designed to suit the monorail size (straight or curved monorail, Which Purchaser will furnish during drawing approval). The travel path of the trolley on monorail (straight / curved) shall be read from BHEL drawing furnished along with the enquiry.

2.4.9.1 For ID Fan and Economiser handling hoists, suitable integral platform shall be provided at hoist to access control panel / motor / trolley / brake etc.,

2.4.10 Frame:

The frame shall be designed to proper strength, built from steel plates with bolted/welded construction.

2.4.11 End Carriages: (For Cranes)

Shall be of minimum 4 wheeled out of which 2 wheels should be spur geared type and fabricated construction. Suitable wheelbase shall be provided. End carriages shall be designed to suit the runway beam size. (Which Purchaser will furnish during drawing approval.) End carriages shall be connected with crane girder by welding or by fasteners (For ease of transportation, if site welding is required, the same shall be done at site by Purchaser).

2.4.12 Crane Girders:

Crane girders shall be of rolled section. Fabricated beam and welded beam shall not be used for this purpose unless otherwise accepted/approved by the Purchaser for special cases. For such cases, refer annexure-I of Section-5 to this specification for details. Camber / deflection under load shall be within SPAN / 1000 mm. In case vendor desires to provide higher camber, the same shall be clearly specified in the drawing. In any case camber provided shall not exceed –

- In case of double girder crane:
(Span ÷1000mm) + (Deflection under self-load of trolley with hoist ÷2)
- In case of single girder crane:
(Span ÷1000mm) + Deflection under self-load of trolley with hoist
Allowable bend shall be 1mm/metre and maximum bend shall not exceed 6mm for total span.

2.4.12.1 Buffers shall be provided for stopping the crane.

2.4.12.2 Design of crane should ensure anti tilting and anti toppling while the hoist is at overhang side.

2.5 Down Shop Leads (DSL):

DSL system shall be designed to transfer the power supply from End user supply point to the equipment, which is moving on runway beams / monorails. The DSL system shall be of Cable trolley type or Taut wire loop type as per contract requirement specified in Section 5.

2.5.1 Cable Trolley Type:

Cable trolleys shall run on "Tee" track / I-Beam. The system shall consist of:

- ❖ "Tee" track
- ❖ Cable Trolleys
- ❖ Flexible power cable (Fixed & Trailing)
- ❖ Switch fuse units / Isolators
- ❖ Supports for Auxiliary girder or "Tee" track / I-Beam
- ❖ Link chain
- ❖ Fasteners

2.5.1.1 Construction:

2.5.1.1a "Tee:" Track / I-Beam:

The system shall be provided with rolled sections suitable for cable trolley wheels as per the relevant Indian Standard. The "Tee" track / I-Beam shall be designed with minimum deflection for smooth travel of cable trolleys.

2.5.1.1b Cable Trolleys:

4-wheeled cable trolleys shall be of sturdy design constructed with suitable material. Diameter of trolley wheels shall be minimum 40mm. and with double seal roller or ball bearing. The cable trolleys shall be designed to take the load of cable and moving with the cable load smoothly on auxiliary girder or "Tee" track. Suitable arrangement shall be provided to tie the power cable and link chain with cable

trolley. Vendor shall specify the construction of material selected in the offer. Arrangement drawing shall be submitted along with the offer for review. After placement of purchase order, the same shall be submitted for approval. Vendor shall indicate the weight of total cable trolleys in the drawing.

**2.5.1.1c Flexible Power Cable: (Fixed & Trailing)
(For Cable trolley & Taut Wire Loop type)**

The trailing cable shall be suitable for 415V AC; 3 phase with neutral; 50Hz.; copper PVC flexible cable, PVC 650/1100V grade, suitable size/rating (for all motors running simultaneously) for the equipment under supply. The power supply flexible trailing cable shall comply with latest revision of IS 694 and other relevant Indian standard for the equipment under supply. If any special requirement, respective IS Standard as mentioned in Section –5 of this specification shall be followed. For sub-vendor list refer clause no 2.12.5. Vendor shall indicate the weight of total system in the drawing.

2.5.1.1d Switch Fuse Units or Isolators: (For Cable trolley type & TW Loop type)

The system shall be supplied along with suitable switch fuse units / isolators to take the full load current, when the equipment trolley with hoist and under hung

crane) is working with maximum safe working load. For sub-vendor list refer clause no 2.12.6.

2.5.1.1e Supports:

The system shall be provided with suitable supports to take the load of “Tee” track / I-Beam, cable trolleys, power flexible trailing and other materials.

2.5.1.1f Link Chain:

The system shall be provided with suitable link chain to pull the trolleys, which is with the load of cable. During pulling of cable trolleys due to impact load, the chain shall not fail at any point. The chain shall be made out of minimum 3mm diameter carbon steel wire.

2.5.1.1g Fasteners:

Suitable fasteners shall be provided. Fasteners shall be electro - galvanized / Hot dipped.

2.5.2 Taut wire loop:

Ceramic reel insulator shall drag on stretched steel wire with trailing cable. The system shall consist of:

- ❖ Bracket
- ❖ End hook
- ❖ Flexible power cable (Fixed & Trailing)

- ❖ Switch fuse units/Isolators
- ❖ Reel insulator
- ❖ Steel wire rope
- ❖ Rope clamp & thimble
- ❖ Leather belt or nylon wire rope
- ❖ Fasteners.

2.5.2.1 Construction:

2.5.2.1a Bracket:

Suitable size and material shall be provided to take the load of cable and axial force by the end hook.

2.5.2.1b End hook:

Suitable end hook shall be provided for the size of steel wire rope.

2.5.2.1c Reel insulator:

Cable reel insulators shall be of ceramic, with suitable size of the stretch wire. Suitable arrangement shall be provided in the reel insulator to tie the trailing cable with nylon rope or leather belt.

2.5.2.1d Steel wire rope:

Steel wire rope shall be of minimum 6mm diameter as per latest revision of IS 2365. Steel wire rope shall be suitably sized for load of cable without sagging for the total travel length.

2.5.2.1e Rope clamp & thimble:

Suitable rope clamps and thimbles shall be provided to tie the rope with bracket through end hook.

2.5.2.1f Leather belt or nylon tie:

Leather belt or nylon tie shall be supplied to tie the trailing power cable with reel insulator.

2.5.2.1g Fasteners:

Suitable fasteners shall be provided wherever required. Fasteners shall be Electro-galvanized / hot dipped.

2.6 Electricals & controls:

2.6.1 CT, LT & Hoisting Motors (AC; Non-Flame Proof)

2.6.1.1 Site condition

2.6.1.1a Altitude above sea level : Less than 500m.

2.6.1.1b Ambient temp. Condition : 0 - 50°C

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2.6.1.1c	Relative Humidity	:100%
2.6.1.1d	Atmosphere	: Dusty, salty, corrosive and highly polluted.
2.6.2	Standard (Latest revision)	: IS 325, IEC 60034, IS 3177
2.6.3	Application	: Trolley with hoist and Under Hung Crane
2.6.4	Duty cycle	: S3/S4; Duty factor: 40% CDF.
2.6.5	No of starts	: 150 starts/Hours
2.6.6	Pullout Torque	: 275 % of the full load torque
2.6.7	Rated voltage, frequency	: 415V, $\pm 10\%$; 50 Hz $\pm 5\%$ and combined 10% absolute
2.6.8	Minimum starting voltage	: 80% of the rated voltage (Cl. 2.6.5)
2.6.9	Capacity to restart (at Voltage Specified in cl.no 2.6.5)	} No limitation on no. of starts. Calls for many starts at frequent intervals. Vendor to specify on any limitation
2.6.10	Direction of rotation	
2.6.11	Class of insulation	: Class 'F' temp. rise limited to class 'B'
2.6.12	Winding treatment:	
	The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot humid and tropical climate	
2.6.13	Temperature rise	: With in specified limits. Vendor to specify.
2.6.14	Starting current	: Vendor to specify.
2.6.15	Method of motor starting	: DOL
2.6.16	Type of enclosure:	
	IP 55 as per IS 4691.	
2.6.17	Terminal Box:	
2.6.18.1	Type	: Weather proof IP 55
2.6.18.2	Cable gland	: Double compression type, Brass with nickel plated
2.6.18.3	Cable entry	: Suitable for both, top and bottom entry.
2.6.19	Type of terminals	: Stud type with plain washers, spring/ washers check nuts & Lugs.
2.6.20	Fault level	: 50 KA at 415V.
2.6.21	Terminals:	
	Separately terminated with clear identification in main terminal box with double compression type glands.	
2.6.22	Lifting device	: Eye bolt or lugs to facilitate safe lifting.

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2.7 Controls & Interlocks:

The control system shall envisage a control cabinet and a push button operating station. The push button control shall have control for power switching to the motors and forward/reverse motion. The control voltage of both cabinet and push button station shall be 110V AC 50 HZ. single phase. The control stations shall have enclosure protection of IP 55 (IS:13947). Necessary electrical interlocks shall be included in control cabinet for fail-safe operation. Vendor shall clearly bring out all the interlocks in the control wiring drawing and submit the same for approval. Limit switches shall be provided for long and cross travel hoists. These switches shall be interlocked to cut off power to the motor and restrict further movement when the limits are crossed. Crimping tool shall be used for fitting lugs.

2.8 Control Cabinet:

2.8.1 Application:

To house all the power contactors, control transformers, control relays, fuses, indicating lamps, switches and protection circuits of all motors of hoist.

2.8.2 Type:

Wall mounting type. Normally mounted on a framework of the hoist. The cabinet shall be made of minimum 1.6mm thick cold rolled sheet.

2.8.3 Motor Protection:

All motor shall be protected against under voltage, over load and short circuit condition.

2.8.4 Isolator :

Input power to the cabinet through switch fuse unit is required.

2.8.5 Thermal over load relays : Shall be provided suitably for all motions.

2.8.6 Indicating Lamps : Shall be provided wherever required.

2.8.7 Terminal Blocks:

Shall be of Clip on type. Shall be suitable for 1.5mm² copper conductor. 20% of additional terminal blocks shall be supplied as spares along with the supply.

2.8.8 Customer Supply voltage : 415V 50 Hz. 3 phase

2.8.9 Control voltage : 110V 50 Hz.

2.8.10 Enclosure Protection: (For Control Cabinet & Pendant Station)

IP 55 as per IS 13947(part I).

2.8.11 Glands:

Shall be double compression type, Brass with nickel plated. To be included in vendor scope as per requirement.

2.8.12 Internal Wiring:

1. PVC 1100V Grade 1.5 mm² multi-strand /copper conductor.

2. All power wiring with red and black.

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3. All control wiring is to be with grey wire & shall be marked with ferules as per wiring diagram.

2.9 Control Box:

2.9.1 Type:

Pendant station to house all start/stop/forward/reverse/up & down push button for all motors.

2.9.2 Location : Hanging from equipment. Push button pendant station shall be provided at above one meter from operating floor.

2.9.3 Push Button:

For all start green push button and for stop red push button shall be used. Make shall be of Siemens / L&T / GE / Telemecanic / BCH/Technic/ Control & Switchgear (C&S) . Push button shall return to "off" position when released. One stop push button shall be lockable to enable switch off power supply when equipment is not in use. The Push Button shall be clearly marked as the recommendation of IS:3938 to indicate the function of each button.

2.9.4 Control Voltage: 110 V AC 50 Hz. Single phase.

2.9.5 Enclosure Protection:

IP 55 as per IS 13947 Part I.

Box material:

Cold rolled sheet steel with 1.6mm thickness minimum.

2.10 Cabling:

Vendor shall include all the power and control cables necessary for the system. The cable shall comply with IS 1554. The power cable shall be of copper PVC flexible and vendor shall indicate the conductor size and over all size in the offer for all the motors. The control cable shall be armoured of 1.5 mm² copper conductor only. The no. of cores, cable size etc shall be indicated in the offer. There shall be 20% spare cores available for all control cables offered. If any special requirement, respective IS Standard as mentioned in Section -5 of this specification shall be followed.

2.11 Earthing :

All electrical equipments (motor, control cabinet etc.,) shall be provided with required elements (like bolt, washer, nut etc.,) for proper earthing at site.

2.12 Electrical & Control Items shall be as per the approved Sub-Vendor/Make List given below.

2.12.1 Control & Thermal Over Load Relays: Siemens/BCH/L&T/GE/ Telemecanic/ C&S

2.12.2 Transformers :SE / Kappa / Ind Coil /JE/ Vikas / Logicstat

2.12.3 Motors : NGEF/Kirloskar/Siemens/Crompton-Greaves /
Bharat Bijlee/Autolec/GEC/Alstom

2.12.4 Limit Switches :BCH / Omron / Nucon / Festo / Siemens / Kaycee /
EMM / SOC

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- 2.12.5 Power & Control Cable :CMI Ltd. / Delton Cables / Fixwell /
Pushincords /Asian cables/Cable corporation
of India / Finolex /Incab/Universal/Polycab/KEI
- 2.12.6 Isolator / Switch Fuse Units : Siemens / L&T / GE / C&S
- 2.12.7 Power Switches : Siemens / L&T / GE / C&S

2.14 Name Plates:

- 2.13.1 Nameplates shall be provided with non-corrosive material
- 2.13.2 Name plates shall have details of the equipment, model no., type, capacity, lift, span, and motor & brake details.
- 2.13.3 All lubrication points shall be provided with nameplates.

2.15 Limit switches and Electrical Protective devices

Limit switches and Electrical protective devices are to be supplied as per IS:3938 - 1983 to limit the ultimate positions of the hook, the hoist block and crane long travel in case of cranes.

3.0 DOCUMENTS TO BE SUBMITTED

3.1 Along with Offer.

- 3.1.1 Quality plan, General arrangement & DSL arrangement / Schematic drawing showing the critical dimensions with complete bill of materials. All dispatchable components / assemblies shall be indicated in detail. Sub-vendor items' make also shall be indicated in the drawing.
- 3.1.2 Wiring circuit diagram with details of make, type and rating of all components.
- 3.1.3 Spares list if required for 3 years of trouble free operation along with price. Commissioning / Initial spares shall form part of the base offer.
- 3.1.4 Duly filled-in and signed General Data Sheet (Section 5) for trolley with hoist, under hung crane and down shop lead system with all required details.
- 3.1.5 Write up on special features if any.
- 3.1.6 Technical specification for equipment.
- 3.1.7 Catalogues and other details of the product shall be submitted along with the offer.

3.1.8 Exclusion:

Any exclusion from scope of supply shall be clearly spelt out in the offer itself. Exclusion of major / critical items shall make the offer liable for rejection.

3.2. After Placement of Order.

- 3.2.1 Quality plan shall be submitted by vendor for Purchaser's approval.
- 3.2.2 Dimensional drawings of Under Hung Crane, Trolley With Hoist, Down Shop Leads, cable trolley, control panel and wiring diagram with B O M for approval.
- 3.2.3 Data sheet (Annexure-III to specification) for hoists and cranes for Purchaser / End user's approval.

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- 3.2.4 The following calculations/details shall be furnished.
- 3.2.4.1 Hoist motor and Travel motor power calculations.
- 3.2.4.2 Brake Torque calculations and Brake selection for each hoist.
- 3.2.4.3 Main Hoist rope and wire rope selection.
- 3.2.4.4 Cross travel and Long travel wheel load and wheel diameter calculations/details.
- 3.2.5 Priced List of Recommended Spares for 2 years trouble free operation and maintenance. (if applicable)
- 3.2.6 After final approval 3 copies of above drawings shall be submitted.
- 3.2.7. Vendor to fill and submit motor data sheet Annexure –IV.

3.3 Along with the Hoists:

- 3.3.1 Physical, Chemical, NDE and hardness test certificates shall be provided wherever applicable for trolley / crane wheels, wire ropes, pulleys, hook, gears, pinions, and shafts.
- 3.3.2 Test certificates for having carried out the tests as per Section-4 of this specification under Purchaser and End user's presence.
- 3.3.3 Test reports for wire rope and hooks.
- 3.3.4 Test reports for NDT examination of gears, wheels, pinions and hooks.
- 3.3.5 Type test and routine test certificates for motors and as per IS 325.
- 3.3.6 Performance test certificates for UHC, TWH, safety devices and other electrical items.
- 3.3.7 TC for control panel, pendent stations and motors shall be provided.
- 3.3.8 The vendor check list shall be filled up at the manufacturer's work and shall be duly signed by inspection engineer and manufacturer's representative.

3.3.9 Drawing & O&M Manuals:

- 3.3.9.1. The bill of material shown in the drawing shall match with that of the dispatchable unit as indicated in the packing slip.
- 3.3.9.2 The drawing shall be prepared in AUTOCAD and vendor shall forward both hard copies (6 copies each) and CD (Copied with drawing files) to the Purchaser.

3.3.9.3 O & M Manuals:

- 3.3.9.4 6 sets of operation and maintenance manuals shall be provided with details for storage, installation, erection procedures, drawings, motor data sheet, relay characteristics, operating and troubleshooting, lubrication schedule, spares data, spares identification drawings, spares replacement procedure and special requirements if any. All copies are to be sent to BHEL / Tiruchirappalli.
- 3.3.9.5 3 sets of CDs for the above manual.
- 3.3.9.6 The hard copies of the Manuals should be in printed form only.

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- 3.3.9.7 The size of manuals should be in correct A4 size with drawings in A3 size. Large size drawings (greater than A3 size) should be reduced in A3 size and inserted.
- 3.3.9.8 Drawings shall be of printed or laser printed form only.
- 3.3.9.9 O & M manuals, (hard copies and CD) shall be submitted to BHEL / Tiruchirappalli prior to dispatch of the equipment.
- 3.3.9.10 Manual, generally should contain the following:
 - 3.3.9.10a Data sheet with makes of components supplied.
 - 3.3.9.10b Maintenance (including, storage, installation, Erection and lubrication wherever necessary) and service
 - 3.3.9.10c Recommended spares for 2 years trouble free service.
 - 3.3.9.10d Trouble shooting
 - 3.3.9.10e Assembly drawings with part list, dimensional drawings & other applicable drawings.
 - 3.3.9.10f Manuals should pertain only to the types or model supplied for the particular contract. Copies are to be sent to BHEL / Tiruchirappalli only.

4.0 TESTING, INSPECTION AND PACKING

- 4.1 Purchaser's and End user's representative shall have access to the works of vendor at all reasonable times for the purpose of witnessing the purchased equipment being tested.
- 4.2. All electrical and mechanical equipment like motor, ropes, cables, electrical control panel etc. shall be tested as per the relevant IS standard at the vendor's / Sub-vendor's works.
- 4.3. The Trolley with hoist shall be run 5 times at manufactures works. First and 5th runs shall be tested with 125% safe working load. Second, third and fourth run with safe working load shall be conducted without any pause. The motor currents shall be checked and shall be with in the rated full load current of each motor at safe working load. The hoist shall be capable of lifting load from mid-air and moving the load without any problem. Normal speed shall be achieved during full load tests. Headroom variation shall be checked & allowable variation is 50mm only. Hook approach shall be checked as per approved drawing. (Ref. Standard : cl.20.2 of IS 3938)
- 4.4. The brakes for hoisting, long travel and cross travel shall be tested with 125% safe working load. The brakes shall be capable of holding this load, when the load is suspended by the hoist hook. As per IS 3177, the long travel motion should be tested at manufacturer's works on no load keeping the crane on sleepers or test bench. Maximum slip (braking path) shall be as per approved data sheet / drawing for hoisting and cross travel motions.
- 4.5 Test shall be conducted for effectiveness of automatic devices for hoist to limit the upward/downward & travel of hoist and to limit the forward & reverse travel of

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crane. The limit switch shall be checked at vendor's works. Others shall be checked at site by Purchaser / End user and if found defective, the same shall be replaced at free of cost by vendor.

- 4.6 Before the hoist is put into operation, over load relays (electrical) shall be tested for lift & cross travel and sustain 125% safe working load. Long travel with 125% SWL shall be tested at site by Purchaser / End user and if found defective, the same shall be replaced at free of cost by vendor.
- 4.7 Trolley with hoist and under hung crane gears shall be tested with & without load for alignments, smooth and trouble-free operation.
- 4.8 Equipment shall be tested for hoisting and cross travel with 125% SWL.
- 4.9 Hoisting, and cross travel speed shall be tested and shall ensure the tolerance within 10%. Hoisting and CT shall be tested for minimum 1.0 to 2.0m. (for hoisting-height & for cross travel-length). Long travel speed shall be tested at site. Vendor shall be responsible for meeting for full lift and lower limit switch operation at site. Any failure at site to meet the above requirement shall be resolved by the vendor at site at his cost.
- 4.10 Long travel shall be tested at site with and without safe working load by Purchaser / End User and if found defective, the same shall be replaced at free of cost by vendor.
- 4.11 Load test for TWH and UHC shall be carried out after installation at site under the supervision of the vendor's representative, to the satisfaction of the Purchaser / End user. Vendor should depute their Engineer for a period of 10 days per boiler free of cost.
- 4.12 All welding shall be tested with LPI / MPI. All butt welds shall be tested with radiography. Acceptance norms for radiography shall be as per AWS D1.1. /ASME Sec IX.
- 4.13 Hooks:**
- 4.13.1 Raw material test certificate shall be submitted by manufacturer for scrutiny.
- 4.13.2 Proof load test should be done as per IS 15560 on each hook irrespective of capacity.
- 4.13.3 After proof load test, hook shall be examined for cracks, deformation, flaws and other defects with LPI / MPI & UT. No linear indications or cracks are acceptable while carrying-out LPI / MPI. Acceptance norm for UT shall be as per A388/ ASME - Section VIII - Division 2- AM203.2 / ASTM E446.
- 4.14 Under Hung Crane:**
- 4.14.1 Check the dimensions of the under hung crane as per relevant standard.

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- 4.14.2 Deflection Test: Under hung crane shall be tested for deflection with safe working load at the middle point of the span. Datum line for deflection is obtained by placing hoist at one extreme of the span with hook approach. The deflection with Safe Working Load at centre of span compared with this datum should be less than= $\frac{SPAN}{1000} mm$.

4.15 Down Shop Lead System (DSL):

- 4.15.1 Cable trolley shall be tested for smooth running on "Tee" track with cable load.
4.15.2 Cable reel insulator shall be tested for smooth running on steel wire rope with cable load.
4.15.3 Any discrepancy found in the design and/or supply shall be resolved by Vendor at the installation (site) at Vendor's Cost.

4.16 Electrical components:

- 4.16.1 The insulation values of all electrical equipments should be checked. Reading shall be not less than 1.0 MΩ with an unregulated type tester with DC voltage not less than twice the rated voltage.
4.16.2 Control panel shall be verified for make, model no. and location of all relays & components as per the approved drawing.
4.16.3 Functional test shall be conducted for power and control circuits.
4.16.4 Test for high voltage and measurement of insulation resistance shall be conducted.
4.16.5 Degree of protection test report shall be submitted. (Type test report)
4.16.6 The satisfactory operation of each controller, switch, contactor relay, other control devices, the connectors of all circuits and protective devices shall be tested under the most unfavourable conditions.
4.16.7 TC for control panel, pendant stations and motors shall be provided.

4.18 Painting, Protection, Packing, Supply and Identification:

4.18.1 Surface Preparation:

Weld slag & spatter shall be removed and the surfaces to be coated shall be free from contamination. Surface defects shall be removed by suitable methods. Sharp edges shall be smoothened by grinding. Prior to surface preparation oil, grease, drilling emulsions, cutting emulsions and preservative agents shall be carefully removed by suitable solvents. The surface shall be carefully dried with clean cloths to prevent the dissolved impurities from spreading over the entire surface. The surface shall be cleaned by wire brush and shot blasting if required. Proper adhesiveness of paint to the surface shall be ensured.

4.18.2 Painting:

Normal painting schedule is as detailed below. For special requirement if any, refer Section-5.0 to this specification.

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4.18.3 **Control cabinet:**

Exterior: Grey; Interior: Brilliant white - glossy finish with enamel paint. For special painting if any, refer Section 5 to this specification. Paint thickness: Exterior - 120 microns; Interior - 80 microns minimum
Alternatively, control panel shall be of powder coated but both outside and inside will be of grey in colour.

4.18.4 Two coat of red oxide with minimum 40 microns DFT as per IS 2074 and two coats of synthetic enamel paint with minimum 40 microns DFT as per IS 2932.

Colour Scheme:

Under hung crane	: Golden Yellow
Trolley with hoist	: Golden Yellow
Interlock mechanism	: Ash Grey
DSL Components	: Ash Grey
Hook	: Black

4.18.5 All the despatchable units shall be packed in a wooden case with waterproof material. The packed item reaching site shall be suitable to be stored in open at site.

4.18.6 The material shall be dispatched with clear bill of material for each system.

4.18.7 Each and every despatchable item shall be identified with item number. Purchase Order reference number and tagged properly for easy identification.

4.18.8 Two sets of as-built arrangement drawings and electrical circuit drawings shall be sent along with the consignment.

5.0 PROJECT RELATED INFORMATION

Project Name :

Enquiry No. / P.O.No. :

Sl.No.	Description	Specification	Vendor Confirmation Yes / No
5.1	Hoist, Crane & DSL Parameter	Refer Annexure-I	
5.2	Power & Control cable code		
5.3	Power supply		
5.3.1	Control supply		
5.3.2	Commissioning Spares	Vendor to specify	
5.4	2 Years recommended spares	Vendor to specify	
5.5	Data Sheet	(Annexure-III) Vendor to fill and submit	
5.6	G.A. Drawings (for hoists, cranes, DSL, Wiring diagram, pendant etc.)	Vendor to submit	
5.7	Motor Data Sheet	(Annexure –IV) Vendor to fill and submit after P.O	
5.8	Special contract requirements		

Note: 1. Deviation in the above requirements shall reject the offer.
2. If required, please add more sheets.

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5.0 PROJECT RELATED INFORMATION

Project Name : Uppur thermal power project (2 x 800 MW)

Enquiry No. / P.O.No. :

Sl.No.	Description	Specification	Vendor Confirmation Yes / No
5.1	Hoist, Crane & DSL Parameter	Refer Annexure-I	
5.2	Power & Control cable code	IS 1554 part (1)	
5.2.1	Power supply	415V, AC, 3PH, 50HZ	
5.2.2	Control supply	110V, AC , 50 HZ	
5.3	Commissioning Spares	Vendor to specify	
5.4	2 Years recommended spares	Vendor to specify	
5.5	Data Sheet for hoist	(Annexure-III) Vendor to fill and submit	
5.6	G.A. Drawings (for hoists, cranes, DSL, Wiring diagram, pendant etc.)	Vendor to submit	
5.7	Motor Data Sheet	(Annexure –IV) Vendor to fill and submit after P.O	
5.8	Special Contract requirement	Attached herewith	

Note: 1. Deviation in the above requirements shall reject the offer.
2. If required, please add more sheets.

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- iii) The Inverter shall be designed as per relevant IS & IEC standard.

16.01.08 Battery, Battery Charger

- i) Battery unit

Battery unit shall be maintenance free Nickel Cadmium type. The capacity of the battery shall be selected based on minimum site ambient temperature and shall be suitable to supply for short time rating of approx. 10 minutes to automatic rescue device control circuit, alarm bell & emergency lighting. The capacity of battery shall be supported with battery sizing calculation.

- ii) Battery Charger

The charger shall have 3 phase full wave controlled rectifier bridge with their protective device. Input voltage shall be 415 V $\pm 10\%$, 50 Hz $\pm 5\%$. Charger shall be suitable for float charge and boost charging.

5.0.0 TESTING AND INSPECTION

- 5.1.0 Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. For the various bought out item test certificates from equipment Manufacturer shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards. Copies of certified reports of all tests carried out at the works shall be furnished.
- 5.2.0 The load test shall be conducted at site for all elevators. The operating license shall be handed over to the Owner.
- 5.3.0 All components shall be tested as per IS: 14665. Test reports shall be furnished for approval. All materials used in manufacture of various components shall be of tested quality and shall conform to relevant standards/specification.
- 5.4.0 Inspection and tests shall be performed in the field in accordance with the requirements and recommendations of respective standards and the local regulation. Testing shall include a comprehensive demonstration of all safety devices, interlocks and controls.

16.02.00 ELECTRICAL DETAILS OF EOT CRANE: (FOR UNDER SLUNG CRANE)



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- 16.02.01 The scope of supply covers all electrical equipment commencing from Isolator, trailing cables, complete down shop leads (DSL) system in the shop and main current collectors on the crane and all other electrical items beyond the main current collectors of the crane i.e. DSL main current collectors, power disconnecting switch on bridge platform after main current collectors, protective and control switch gear ,motors, VVFD, control and brake panels ,resistors, brakes, limit switches, all power and control cables, socket outlets, lighting distribution panel and lighting fixtures with lamps, festoon cable system for crane trolley magnet/ grab and cable reeling drum, if specified for grab/magnet, master controllers, indicating lamps, push buttons, earthing materials etc. The scope of work also includes complete assembly and wiring of crane and testing at manufacture's works, erection and testing and commissioning of all electrical equipment.
- 16.02.02 All sundry erection materials required for installation and connecting up of electrical equipment with cable laying and fixing accessories shall be included in scope of supply by Bidder.
- 16.02.03 Power supply to the crane shall be from the 415V ACDB as shown in the Electrical SLD.
- 16.02.04 Power supply and Standard voltage levels
- i) The following standardized voltage levels shall be adopted:-
- 1) LTAC : 415V, 3 phase, 50 Hz, 4 wire solidly earthed system. Power supply be made available at this voltage only. Other voltages shall be obtained by providing transformer/ transformer – rectifier unit with MCBs on both primary and secondary side and $\pm 5\%$ and $\pm 10\%$ taps on transformers secondary.
 - 2) AC control and signaling : 110 V AC voltage
 - 3) Socket outlets for
 - i) Hand lamps : 24 V, single phase, 50 Hz, AC obtained through suitable transformers
 - ii) Hand tools : 240 V, 15A, 2 pin plus earth with plug interlocked switch
 - d) Electro-magnetic brakes : 220 V, DC obtained through individual brake control panels.



- 4) Monitoring and signaling : 24/ 48 V. DC
in electronic installations,
mimic panels
- 5) Illumination/ lighting : 240 V, AC
The three phase symmetrical short-circuit ratings of the switch gear
at 415 V shall be 50 kA for 1 second.
The system/ unit/ equipment shall be designed so as to be suitable
for the following variations in voltage and frequency :
- | Voltage | Frequency |
|---|---------------------------------------|
| Permissible variations with
rated performance, rated
current and control
effectiveness maintained | $\pm 10\%$ +5% & -5%
For LT system |
| Permissible variations for
control and regulation
equipment with rated
performance and control
quality maintained | $\pm 10\%$ +3% & - 6% |

16.02.05 Standards

- i) The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision). In case the Bidder is not in a position to comply fully with certain BIS specifications, or in respect of certain items for which there are no IBIS specifications, the Bidder may base his proposals on IEC recommendations or other reputed national or international standards subject to the approval of the Purchaser.
- ii) All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India and the Government of Uttar Pradesh and with the Indian Electricity Rules
- iii) Wherever specified, a set of batteries, a battery charger, one annunciation system and other accessories shall also be provided along with magnet so that the magnet can hold the full load for at least half an hour in case of power failure.

16.02.06 Equipment in operator's cabin and on pendant unit

- i) Following shall be included on the pendant unit:

Push button for	Hoist slow, hoist fast, lower slow, lower fast, left cross traverse, right cross traverse, forward long travel, backward long travel, emergency stop conditions.
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Switch for	Lights and bells
Lamps for	Power 'ON' indication, Control "ON" and emergency corner switch operation.

ii) The Pendent Push Button station shall be supported independently, earthed separately independent of suspension.

iii) Cabin operated cranes:

a) The operator's cabin shall contain the following:-

- 1) Master controllers for all the motions and magnet (wherever applicable).
- 2) Emergency stop push button.
- 3) Foot switch for alarm or bell.
- 4) Switches for all lighting equipment on crane.
- 5) Switches for exhaust fan and for cabin fan.
- 6) A fire extinguisher.
- 7) Insulating mat and operator's chair.
- 8) Cabin light and fan.

Annunciation panel with indication lamps for power 'ON' control 'ON' emergency corner switch operated, ammeter and voltmeter with selector switches.

iv) Radio remote control:-

a) In this mode of control system, all the 3 motions

- 1) Hoist.
- 2) Main/creep for main hoist &aux hoist separately.
- 3) Cross travel and Long travel can be controlled.

b) The system shall have capability to provide range of 1.5 times the long travel distance of the crane.

c) In the case of signal failure, all motion shall come to a safe stop.

d) The system shall have facility of controlling speed in two steps:-

- 1) Slow speed on the first step of the breaker contact / pushbutton of the radio remote control representing the first or second notch of the master controller.
- 2) Full speed on the second step of the breaker contact / pushbutton of the radio remote control representing the final notch of the master controller.



v) Transmitter:-

a) Transmitter shall have following features:-

- 1) Constructed with sophisticated microprocessor technology and surface mounted electronics.
- 2) Transmission type: - FM FSK
- 3) Transmission speed: - 9.6 Kbps.
- 4) Built in self test for all functions.
- 5) Transmitter shall consist of switching breaker, dial switch and push buttons.
- 6) Switching breaker shall be non locking to zero position or maintained function.
- 7) Indications:-
- 8) Operation status
- 9) Battery status
- 10) Indicators that display information from crane.
- 11) PIN -code (Personal Identification Number)
- 12) Internal antenna.
- 13) Rechargeable battery.
- 14) Battery 7.2 V NiCd
- 15) Operating time: - About 8 hours.
- 16) Different operating frequencies (minimum 16 nos.)
- 17) Two hand upstart.
- 18) Stop push button.
- 19) Operating conditions: - Areas having large temperature variations, dusty, more vibrations, oil and humidity.
- 20) Operating temperature range: - Min. 10 deg.C to Max. 60 deg.C
- 21) Protection class: IP - 54.
- 22) Casing material: Polycarbonate / ABS plastic.

vi) Receiver:-

a) Receiver shall have following features:-

- 1) Upto 20 functions exclusive safety relays (for transmitting preset reference values to VFD in the crane).
- 2) 2 safety relays (for control of main contactor)
- 3) Power supply suitable for 240 V AC, 6 A.
- 4) Minimum 16 different operating frequencies.
- 5) Two redundant microprocessors for monitoring each others.
- 6) Cyclically redundancy checks check for high security of transmitted radio messages.
- 7) Frequency scanning in the receiver.
- 8) Memories last 10 users.



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- 9) Interlocking of the relays.
 - 10) Momentary or latched relay functions.
 - 11) Two hand up start (to avoid unintentional start).
 - 12) Protection class: IP - 65.
 - 13) Casing material: Aluminium profile for fast mounting on DIN rail
 - 14) Operating temperature range:- Min. 10 deg.C to Max. 60 deg. C

vii) Enclosure Class

- a) For indoor operations
 - 1) Resistance boxes : IP : 11
 - 2) Motors : IP : 54
 - 3) All other electric equipment : IP : 54
- b) For outdoor operations
 - 1) Resistance boxes : IP : 33 with canopy
 - 2) Motors & panel : IP : 55 with canopy
 - 3) All other electrical equipment : IP : 65 with canopy

16.02.07 Cables (For EOT Only)

- i) Power cable suitable for 3 Phase, 4 wire, AC power supply system.
- ii) All cables shall have stranded copper conductors. Control wiring shall be with 2.5 mm² copper; minimum size of power cable shall be 6.0 mm². Fixed wiring on cranes shall be carried out with XLPE insulated. PVC sheathed armoured cable or EPR insulated CSP sheathed cable or better.
- iii) All flexible cables (i.e. cables for magnet, trolley, feed, pendant unit etc.) shall have copper conductor, EPR insulation and CSP sheathing or better.
- iv) All cable shall be suitably de-rated for grouping and higher ambient temperature.
- v) All cables shall be of 1100 Volts grade.
- vi) All accessories like cable glands, clamps, pipes, wire and terminal marks etc. shall also be provided.
- vii) Cable laying and terminations shall be such that the chances of cables getting damaged is remote.
- viii) Cable sizes shall be selected considering motor rated current.
- ix) In all passages and on trolley the cable shall be laid in trays and shall be covered by similar trays and properly clamped & fixed:-



a) LT Power Cable

1.1 kV, heavy duty power cable, 4/3.5 core with stranded sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) Copper conductors as applicable, XLPE insulated operation as per IS:5831-1984, core stranded together provided with a common covering of Extruded FRLS PVC inner sheath of type ST2, galvanized round steel wire / strip armoured and Extruded FRLS PVC TYPE ST2 outer sheathed, multi core conforming to IS:1554 (Part-I – 1988) Type TWY.

b) Control Cables

1.1 kV, circular stranded (rm), annealed copper conductor, PVC insulated suitable for type ST1 (70°C) operation, as per IS:5831-1984, cores stranded together provided with a common covering of PVC inner sheath, galvanised round steel wire armoured and Extruded FRLS PVC outer sheathed, multi-core similar to IS:1554- (Part-I)-1988, Type YWY.

c) Flexible Trailing Cable

1.1 kV grade, heavy duty type with tinned annealed high conductivity flexible copper conductors, ethylene propylene (EPR) insulated and chlorosulphorated polyethylene (CSP) sheathed conforming to IS:8130-1984, IS:6380-1984 and IS:9968 (Part-I)-1988.

16.02.08 Earthing

- i) A ring earthing system shall be provided on the crane. Each and every electrical equipment shall be connected to this earthing at least at two points. However the electronic circuit insulated earth wire shall run in panel and terminate at main earth connection only at one point. The earthing shall be connected to the fourth trolley line in DSL system through 2 nos of current collector. Additionally current collectors shall also be provided on crane rails for earthing on crane . All these collectors shall be connected to earthing ring.
- ii) An earth core shall be provided in trolley feed cable and the magnet. The cable reeling drum shall have a separate slipring for earthing purpose.
- iii) It shall conform to general specification for earthing.



- iv) Rubber mattings shall be provided in front of the protective and control panels.
- v) All bonds between earth conductors and crane parts shall be welded if possible, or rivetted and soldered. Where screwed bonds are made, care shall be taken that there is satisfactory contact surface and nuts shall be locked to prevent their loosening? Earth connections to equipment shall be made by means of multi strand flexible conductor to adequate section.
- vi) The earth ring on the crane/ machine shall be connected to the plant earthing system through to gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system.
- vii) In addition, intermediate earthing bond shall also be provided on the rails at every 60 m in case of longer tracks.
- viii) Flexible copper bonds shall be provided across any gap in the running gantry rail. For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

16.02.09 Operation

- i) The crane shall be operated either from cabin in the crane bridge and from a pendant control station and through remote control unit as specified in Data Specification Sheet

16.02.10 ~~Operator's Cabin~~

- ~~i) The operator's cabin shall be steel fabricated closed cabin type, and air conditioned, fire proof construction and complete with light, fan and seat. The cabin shall be located on one end of the crane bridge and 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. A clear headroom of 2000 mm shall be ensured within the cabin. The cabin shall be well braced in order to provide adequate strength and rigidity. The outside surfaces of the cabin and floor beams shall present smooth and pleasing appearance.~~



- ii) A foot operated type-warning gong shall be provided within the cabin. The cabin shall be compact and adequately sized (approximately 2.5x2x2.3 meters dear high) to accommodate controllers, protective panel, distribution board and other accessories required for operating the crane. Arrangement shall be such as to provide unrestricted view of load at any position to the operator.
- iii) Dead man's Handle/Control for each of the crane motions shall be provided in the cabin.
- iv) Cabin's platform shall be provided with 10 mm thick rubber sheet on the floor to comply with I.E. Rules. No wooden paneling shall be permitted. The sides of the cabin shall be covered with plate steel to a height of one (1) metre. The floor shall be designed for a load of 300 kg per metre square of floor area exclusive of the weight of any equipment mounted on or attached to the cab. An access ladder shall be provided from the bridge girder to the Operator's cabin.
- v) In addition to above, accessories not limited to the following shall be adequately arranged/ mounted in the cabin:-
 - a) Manually operated master control switches, main line disconnecting switches and other necessary controls and wiring with fittings.
 - b) A swing way operator's chair.
 - c) Complete concise instructions covering the crane operation, maintenance and periodical lubrication etc typed in English and neatly framed in a permanent frame for each reference.
 - d) A non-oscillating-ventilating fan having 350 mm swing (240V AC, single phase) with suitable guard, and separate regulator.
 - e) Adequate fluorescent illumination with switch inside the cabin.
 - f) An electric alarm gong and an additional 300 mm dia hand operated metal gong.
 - g) Portable carbon dioxide fire extinguisher and sand bucket.
 - h) One No Suitably rated window Air conditioner.
- vi) Location of the cabin shall be on one side of the crane so as to permit maximum visibility of all operations of the crane. Location of cabin and/or access ladder shall be such as to prevent personnel from making accidental contact with crane and/or trolley runway conductors.
- vii) Enclosure protection class of all Electrical equipment shall be at least IP 54 or better except that for motor which shall have IP-55 protection & Resistance boxes, which may have IP-23 protection.

16.02.11

Pendent Station



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- i) The pendent 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 metre above the operating floor.
 - ii) With pendent operation, foot operated travel brake and the drum controllers need not be provided.

16.02.12 Repair Cage

- i) 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 to these conductors.
- ii) Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.
- iii) 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.

16.02.13 Guarding

- i) Guards of an approved design, which shall 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.
- ii) Protection guards to live electrical wirings/conductors shall be provided.
- iii) Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.
- iv) The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent trapping of a hand between a sheave and the in running rope.
- v) 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.
- vi) 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.
- vii) All electrical panels, resistance boxes and crane trolley wires 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 the completion of the building roof.



16.03.00 ELECTRICAL DETAILS OF HOISTS

16.03.01 Bidder's scope of supply shall include the following:-

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

16.03.02 Standards

- i) The equipment shall be selected as per the guide lines provided in the latest edition of the relevant Indian Standards. The equipment shall also conform to the latest Indian Electricity Rules & other statutory Regulations prevalent at the place of installation as regards to safety requirements, earthing & other essential provisions specified therein.
- ii) Following shall be followed:
 - a) Indian Standards, relevant international standards such as IEC, VDE, BS, JIS, NFPA etc.
 - b) Indian Factory Act 1948
 - c) Indian Electricity Act 1910
 - d) Indian Electricity rules- 1956, State's regulations.
 - e) Electricity regulatory commission Act 2002.
 - f) Ambient conditions
 - g) All electrical equipment including cables shall be selected for an ambient temperature of 50 deg C and relative humidity of 88 %.



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- 16.03.03 Power supply condition
- i) Power supply to the hoist shall be 415V +/- 10%, 3 phase, 50Hz +/- 5% AC 4 wire with solidly earthed neutral to be tapped from ACDB as shown in electrical SLD.
 - ii) The following voltages shall be used in the hoist:-
 - a) 415 volts, 3 phase, 50 HZ - for motors 110 volts, single phase, 50 Hz -for electrical circuit of pendant control / control posts. 220 volts, DC for DC electromagnetic brakes.
 - b) The different voltages mentioned above, other than 415 V, 3 phases, 50 Hz shall be obtained through individual separate transformers & transformer rectifier units connected to 415 V.
 - iii) Each transformer shall be provided with tapplings at +5% & + 10% on the primary.
 - iv) Electrical system shall be designed for a fault level of 50 kA. Earthing system adopted shall be type TN-CS.
- 16.03.04 Power supply collection & distribution
- i) Incoming power supply to the hoist shall be terminated at the line side terminal of sheet steel, dust proof cable junction box installed near hoist gantry in an accessible position. Bidder shall provide proper flexible festoon cable system/ DSL arrangement in case of Turbine hall hoists to deliver the power supply to the electrical control panel of the hoist. Electrical control panel of hoist shall contain following equipment/devices:-
 - a) A three pole isolator with suitably rated fuses to take care of the system fault. The rating of the isolator shall be sufficient to carry the combined full load currents of the hoist & travel motor.
 - b) A three pole main line magnetic contactor suitable to carry the combined full load currents of hoist & travel motor.
 - c) Fuse & over load relays in the individual motor power circuit. The over load relays shall be self reset type.
 - d) Reversing contactors for individual motor. The rating of the contactors shall be atleast 50% higher than the respective motor full load current at the specified duty cycle. The minimum rating of the power contactor shall be 30 amps. It shall be heavy duty & of class AC-4 as per IS: 2959-1985.
 - e) Transformer & transformer rectifier set for control voltage supply & for supply to DC electromagnetic brakes respectively.
 - f) Speed control equipment as necessary. Plugging of motors shall be avoided by suitable control.
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- ii) Suitable arrangement shall be provided to intimate control room during emergency in the form of audio-visual alarm. Necessary contacts/auxiliary relays shall be provided.
- iii) The electrical panel shall be sheet metal clad (16 gauge), totally enclosed (IP-54) with hinged & gasketed front door. Cable entry/exit shall be through compression type cable glands.
- 16.03.05 Pendant control station
- i) All drive motors shall be controlled with individual magnetic reversing type contactors operated through momentary contact push buttons (mounted on pendant unit/ control posts. The push button shall return to the 'off' position as soon as the pressure is released. The release of the push button shall immediately & automatically cause the brake to clamp. In addition to the start up 'ON' push button, which energises the main contactor, one lockable 'OFF' push button shall be provided in the push button station & shall be connected in the main contactor coil circuit. The push buttons shall be clearly marked as per the recommendations of IS: 3938-1983 to indicate the function of each button.
- ii) The pendant unit shall be fixed either to the hoist unit or to the monorail as specified. It shall be capable of withstanding rough handling without damage. The weight of the pendant shall be supported independent of cable by means of PVC sleeved chain or wire rope. The pendant shall be effectively earthed. A chain or rope does not provide an effective earth connection & shall not be relied upon for that purpose.
- iii) The reversing contactors for individual motors shall be electrically interlocked. The control scheme adopted shall ensure smooth normal speed lowering, hoisting & travel as specified.
- iv) The pendant shall comprise of following push buttons and indicating lamps.
- a) Start & stop
 - b) Trolley travel to & fro
 - c) Hoist & lower
 - d) Red lamp for supply ON
- 16.03.06 Limit switches
- i) Hoist & travel motion shall be provided with limit switches to limit the ultimate positions of the hook & the hoist block.
- ii) The limit switches shall conform to the requirements specified in IS: 3938-1983/ International Standards.
- 16.03.07 Motors
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- i) All motors shall be totally enclosed fan cooled, crane duty, squirrel cage induction motors. It shall be ensured that these are special motors suitable for crane duty with pull out torque of not less than 150% of the rated torque. Motors shall conform to IS:325-1996 . All motors shall be suitable for 60 starts/hour.
- ii) The motors shall be selected for the duty class of hoist unit. The duty cycle factor for each motor shall not be less than 40%.
- iii) The motor selected shall be suitable for frequent reversal, braking & acceleration. Motors shall have class 'F' insulation with max. utilisation to within class 'B' admissible temperature rise corresponding to ambient air temperature as per clearance diagram. All windings shall be impregnated for service in the tropics having ambient temperature as stated in the clearance diagram of the hoist.
- iv) Each motor shall have a robust terminal box accurately fixed to the frame. Each terminal box shall have ample room for termination of the aluminium conductor cables.

16.03.08 Brakes

- i) Separate electromagnetic brakes, operated through direct current shall be provided for each motor driven mechanism. Brakes shall be of approved make & shall be connected so as to apply automatically when power supply fails or when the push button is released or with adjustable delayed time lag preceded by electrical braking when the push button is released.
- ii) Brakes shall be designed as per the latest edition of IS: 3938-1983/ International Standards.
- iii) Disc brake may be provided for CT motion and shoe brakes may be provided for hoist motion.

16.03.09 Wiring

- i) Fixed wiring on the hoist block shall comply with following requirement:-
 - a) All cables shall be installed with adequate protection against mechanical damage & damage from weather. Alternatively, multi-core armoured power & control cables, suitably clamped, may be used. Suitable clamping glands shall be provided at both ends of each multi-core cable.
 - b) All power & control cables shall be tagged at both ends (as per approved drawings) for quick identification. The cables & wiring system for each motion shall be independent & common runs shall be avoided. Power cables & control cables shall be



effectively separated & all connections shall be terminated to terminal box suitable for outside connections.

- c) Cable runs shall avoid locations where high temperature and mechanical damage are likely to be experienced under service conditions.
- d) Adequate precautions shall be taken to prevent ingress or collection of water or oil in any part of conduit or trunking system.

16.03.10 Enclosure class

- i) The equipment in the hoist shall be suitably protected against direct radiant heat and rain. It shall be rendered proof against ingress of dust and vermin.
- ii) All electrical equipments like motors, junction boxes, electrical panel, limit switches, brakes etc. shall be provided with enclosure class IP-54 for non-dusty or indoor environment and IP-55 for outdoor application.
- iii) Canopy shall also be provided for outdoor hoist.

16.03.11 Cables (For Hoists only)

- i) The cables for power connection on the hoist block unto electrical panel shall comprise multi-strand XLPE insulated and FRLS PVC sheathed, copper conductor, 1.1 kV grade cables. The conductor sizes shall be selected after derating for the high ambient temperature, grouping & disposition of cables & keeping the voltage drop within the permissible limits & shall have a minimum cross sectional area of 4 mm² copper.
- ii) Conductor for control cables from electric hoist to electrical panel shall be made of copper with standard construction & with a sectional area not less than 2.5 mm². Festoon flexible cables for power & control applications shall have EPR insulation & CSP sheathing. Flexible cables shall be of finely stranded copper conductor having a min. Conductor section of 4 mm sq. copper for power circuits & 2.5 mm sq. for control circuits.
- iii) All cables shall be adequately protected against mechanical damage, radiant heat & oil.

16.03.12 Power collection system

- i) Power supply to the hoist unit shall be through flexible festoon cable system. The festoon cable shall be mounted on a retracting roller



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supports for the full length of the working zone parallel to the I beam carrying the hoist unit. The retracting trolleys shall run on a separate supporting beam. Vendors shall specify the supporting beam according to the retracting rollers offered by him to enable provide such beam in the building structure.

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

16.03.13 Earthing

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

16.04.00 ELECTRICAL DETAILS OF EOT U/S CRANE

The electrical details of electrically operated under slung crane are same as the electricals of electrically operated (EOT) crane as described in Cl. 16.02.00 above except that operator cabin, cabin operated cranes and radio remote control mentioned at Sl. No. 16.02.10, 16.02.6 (iii) 16.02.6 (iv) are not applicable.

