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ELECTRICAL OPERATED HANDLING EQUIPMENTS

1.0 SCOPE: This specification covers design, manufacture, inspection, testing and supply erection & commissioning of electrically operated Under Hung Crane (UHC), Trolley with Hoist (TWH), Down Shop Leads (DSL) and male & female interlock mechanisms. Technical parameters for equipment design are furnished in Annexure-I. For scope of supply and special requirements refer to Annexure II. Annexure III comprises data sheets, which are to be duly filled in by the vendor and shall be submitted along with contract documents during execution of purchase order..

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 particular project, if any, are specified at the time of sending Enquiry to vendors.

2.0 CODES AND 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.

2.1 IS 3938 - Electric wire rope hoists.
2.2 IS 807 - Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.
2.3 IS 2758 - Mild steel point hooks for use with wire rope thimbles.
2.4 IS 15560 - Point hooks with shanks for general engineering purpose.
2.5 IS 2266 - Steel wire rope for general engineering purpose.
2.6 IS 3681 - General plan for spur and helical gears.
2.7 IS 325 - Three phase induction motor
2.8 IS 9968 - Elastomer insulator cables for working voltage up to and including 1100 V
2.9 IS 4691 - Degrees of protection provided by enclosures for rotating electrical machinery
2.10 IS 2062 - Weldable structural steel.
2.11 IS 816 - Code of practice for metal arc welding for general engineering construction in mild steel.
2.12 IS 2074 - Ready mixed paint air drying red oxide-zinc chrome, priming.
2.13 IS 2932 - Enamel synthetic, exterior (a) under coating, (b) finishing.
2.14 IS 3177 - Code of practice for electric over head traveling crane and gantry crane, other than steel work cranes.
2.15 IS 13947 (Part I) Specification for low- voltage switchgear & control gear
2.16 IS 1024 - Code of practice for use of welding in bridges and structures subjected to dynamic loading

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2.17 IS 2004 - Carbon steel forgings for general engineering purpose.
2.18 IS 1835 – Round Steel wire for ropes

3.0 DESIGN AND CONSTRUCTIONAL REQUIREMENTS:

Design and manufacture of TWH, UHC, DSL, interlock mechanism shall be of consistent capacity, lift, headroom, span, over hang and any other parameters as specified in Annexure-I.

3.1 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 deg 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 HOIST & UNDER HUNG CRANE

3.1.1. HOOKS: Hooks shall meet the dimensional, material testing & inspection requirement of IS 15560 , which ever is applicable. The hook shall be provided with standard depress type safety latch and swivel thrust bearings with hardened race. Lugs for fixing safety latch shall be either forged along with the hook or clamp type latch with lugs shall be provided. Welding of lugs not permitted. Locking arrangement shall be provided to avoid unscrewing of the hook in service. Material of hook shall be conforming to IS-2004 - 35C8 or equivalent (with minimum tensile strength 50 kg/ sqmm) and made by controlled grain forging and normalized. All the hooks shall be tested for twice the safe working load. All hooks shall be examined by MPI/ LPI & UT (UT required for hooks > 5.0 T capacity) for cracks after proof load test. The hook shall not distort or fracture. Ball & roller bearings shall not be used in these hooks for the swivel thrust bearing.

3.1.2 WIRE ROPE: Wire ropes shall meet the requirement of IS 2266. Shall have six strands of 37/36 wires per strand with an ultimate tensile strength of 180 kg/ sq.mm. 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. The rope shall be of sufficient length to retain two full wraps on the drum at lowest hook position.

3.1.3 DRUM AND 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

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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.

3.1.4 GEARS AND PINIONS: Material of construction shall be conforming to relevant Indian Standard or equivalent and case hardened. Hardness for Cross Travel & Long Travel (CT & LT) shall be in the range of 250 - 290 BHN for pinions and 215 - 255 BHN for gears. Hardness for hoisting shall be in the range of 285 - 300 BHN for pinions and 250 - 265 BHN for gears shall be maintained. However, Vendor shall maintain and ensure that gear hardness is always less than pinion hardness by atleast 35 BHN. Helical/ Spur gears shall be used for hoists, CT & LT gears. All gears and pinions shall be examined by LPI/ MPI for surface cracks after hardening. Incase of enclosed gearing, means shall be provided for ample lubrication. Such lubrication points are to be indicated in the drawing. The specification of lubricant, market trade names, quantity of lubricant requirement and frequency of lubrication shall be specified by the vendor.

3.1.5. WHEELS: Shall be made out of **forged** 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 **forged** 4 wheeled & driven by motor.

3.1.6 ROTATING AND 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/ sq.mm and hardness shall be in the range of 175 to 250 BHN. Shafts shall be tested with UT for more than 50 mm dia. UT acceptance norms shall be as per ASME section VIII: Division 2.

3.1.7 BEARINGS: Shall be reputed make (FAG/SKF/TIMKEN/NSK/TORRINGTON) and shall meet relevant IS standards. All bearings shall be designed to give a minimum service life of 20 years. Only antifriction bearings shall be used.

3.1.8 BRAKES: Hoisting, cross travel and long travel shall be provided with electro-mechanical friction shoe type brake or conical/parallel disc type brakes. 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.

3.1.9. TROLLEY: Shall be of Minimum 4 wheeled spur geared type and fabricated construction. Trolley shall be designed to suit the monorail size (which will be furnished by Purchaser during drawing approval stage).

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

3.1.11 END CARRIAGES: Shall be of 4 wheeled spur geared type and fabricated construction. Suitable wheel base shall be provided. End carriages shall be designed to suit the runaway beam size (which will be furnished by Purchaser during drawing approval stage). 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).

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

* **In case of double girder crane:**
Span/ 1000 mm plus deflection under self load of trolley with hoist/2
*** In case of single girder crane:**
Span/ 1000 mm plus deflection under self load of trolley with hoist
Allowable bend shall be 1 mm/ meter and maximum bend shall not exceed 6 mm of total span.

3.1.13 Buffers shall be provided for stopping the crane.

3.1.14 Suitable anti tilt, roller arrangement and anti topple arrangement shall be provided in between runway beam and crane girder to avoid toppling of the equipment while the hoist is at overhang side.

3.1.15 Suitable approach platform should be supplied loose which can be mounted at suitable location at site to access control panel/ motor/ trolley/ brake etc.

3.2 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.

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3.2.1.0 **CABLE TROLLEY TYPE**: Cable trolleys shall run on "Tee" track.
The system shall consist of:

3.2.1.1 "Tee" track.
3.2.1.2 Cable Trolleys
3.2.1.3 Flexible power cable (Fixed & Trailing)
3.2.1.4 Switch fuse units/ Isolators
3.2.1.5 Supports for Auxiliary girder or "Tee" track
3.2.1.6 Link chain
3.2.1.7 Fasteners

3.2.2.0 CONSTRUCTION:

3.2.2.1 "Tee" TRACK: The system shall be provided with rolled sections suitable for cable trolley wheels as per the relevant Indian Standard.

3.2.2.2 CABLE TROLLEYS: 4 wheeled cable trolleys shall be of sturdy design constructed with suitable material. Diameter of trolley wheels shall be minimum 40 mm 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 trolley in the drawing.

3.2.2.3 FLEXIBLE POWER CABLE: The trailing cable shall be suitable for 415 V AC; 3 phase with neutral; 50 Hz; Elastomer insulated cable, 650/ 1100 V 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 9968.** For sub-vendor list refer clause no. 3.12.0. Vendor shall indicate the weight of total cable in the drawing.

3.2.2.4 SWITCH FUSE UNITS or ISOLATORS: The system shall be supplied along with suitable 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. 3.12.0.

3.2.2.5 SUPPORTS: The system shall be provided with suitable supports to take the load of "Tee" track, cable trolleys, power flexible trailing and other materials.

3.2.2.6 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

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Impact load, the chain shall not fail at any point. The chain shall be made out of minimum 5-mm diameter carbon steel wire.

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

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

3.2.3.1 Bracket
3.2.3.2 End hook
3.2.3.3 Flexible power cable (Fixed & Trailing)
3.2.3.4 Switch fuse units/ Isolators
3.2.3.5 Reel insulator
3.2.3.6 Steel wire rope
3.2.3.7 Rope clamp & thimble
3.2.3.8 Leather belt or nylon wire rope
3.2.3.9 Fasteners.

Typical arrangement drawing shall be submitted for Purchaser's review and approval.

3.2.4 CONSTURCTION:

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

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

3.2.4.3 Flexible power cable (Fixed & Trailing) : The trailing cable shall be suitable for 415V AC; 3 phase with neutral; 50 Hz; Elastomer insulated cable, 650/ 1100 V grade, suitable size / rating (all motors running simultaneously) for the equipment under supply. The power supply flexible trailing cable shall comply with latest revision of **IS 9968.** For sub-vendor list refer clause no. 3.12.0.

3.2.4.4 SWITCH FUSE UNITS or ISOLATORS: The system shall be supplied along with suitable 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. 3.12.0.

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

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3.2.4.6 Steel wire rope: Steel wire rope shall be of minimum 6 mm diameter as per latest revision of IS 2266. Steel wire rope shall be suitably sized for load of cable without sagging for the total travel length.

3.2.4.7 Rope clamp & thimble: Suitable rope clamps and thimbles shall be provided to tie the rope with bracket through end hook.

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

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

INTERLOCK MECHANISM (Male & Female)

3.3.0 Interlock mechanism (male & female): Male & female interlock mechanism shall be designed to transfer the trolley with hoist with rated safe working load from master crane to slave crane or master crane to fixed monorails and vice versa. The interlock mechanism shall be capable of withstanding the forces when even one of the cranes is being operated by mistake. The cross travel stoppers should give way to the hoist when interlock mechanism is coupled. Dimensional tolerance for the male & female component of the interlock mechanism shall be very close which will ensure proper locking without play and smooth transfer of trolley from one crane to the other.

3.3.1 Hand wheel with chain of suitable length shall be provided to operate the male & female mechanism manually from operating floor.

3.3.2 Male and female interlock mechanism shall be designed suitably to take the axial load and safe working load.

3.3.3 Typical arrangement drawing showing the details shall be submitted with offer.

3.4 LUBRICATION: Grease nipples shall be provided at all lubrication points. The lubrication points shall be easily accessible. Frequency of lubrication shall be minimum. Oil bath lubrication shall be preferred.

3.5 FASTENERS: All fasteners shall be made of precision grade high tensile steel (Grade 8.8 class) and galvanized as per relevant Indian Standard. Load bearing fasteners shall be of specially machined bolts with suitable material and preservatives applied on it. For special bolts/ fasteners, vendor shall furnish material, tensile strength and hardness in the arrangement drawing.

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3.6.0 ELECTRICALS AND CONTROLS

3.6.1 CT, LT AND HOISTING MOTORS (AC; NON-FLAME PROOF)

3.6.1.0 Site condition

3.6.1.1	Altitude above sea level	:	Less than 5000 m
3.6.1.2	Ambient temp. condition	:	0-50 ° C
3.6.1.3	Relative Humidity	:	100%
3.6.1.4	Atmosphere	:	Dusty, Salty, corrosive and highly polluted.
3.6.2	Standard (Latest revision)	:	IS 325
3.6.3	Application	:	Trolley with hoist and under Hung crane.
3.6.4	Duty cycle	:	Continuous S3/S4; Duty factor: 40% CDF.
3.6.5	Rated voltage, frequency	:	415 V ± 10%, 50 Hz ± 5% and combined 10% absolute.
3.6.6	Minimum starting voltage	:	80% of the rated voltage (Cl. 3.6.5)
3.6.7	Capacity to restart (at Voltage specified point no. 3.6.5)	:	No limitation on no. of starts. Application calls for many starts at frequent intervals. Vendor to specify on any limitation.
3.6.8	Direction of rotation	:	Bi-directional.
3.6.9	Class of insulation	:	Class ‘F’ temp. rise limited to class ‘B’.
3.6.10	Winding treatment	:	The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot humid and tropical climate.

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3.6.11	Temperature rise	Within specified limits. Vendor to specify.
3.6.12	Starting current	Vendor to specify.
3.6.13	Method of motor starting	DOL
3.6.14	Type of enclosure	IP 55 as per IS 4691. Weather protection type test certificate shall be furnished. Drawing showing constructional features of item subjected to weather protection test should form part of test certificate and drawing no. shall appear on TC.
3.6.15.0	Terminal Box	
3.6.15.1.	Type	Weather proof IP 55.
3.6.15.2	Cable gland	Double compression type.
3.6.15.3	Cable entry	Suitable for both, top and bottom entry.
3.6.16	Type of terminals	Stud type with plain washers, spring washers/ check nuts & Lugs.
3.6.17	Fault level	50 KA at 415 V
3.6.18	Painting	Epoxy based paint with Grey colour & 40 microns DFT (Minimum)
3.6.19	Terminals	Separately terminated with clear identification in main terminal box with double compression type glands.
3.6.20	Lifting device	Eye bolt or lugs to facilitate safe lifting.
3.6.21	Documents to be furnished along with offer	1. Technical data sheets as per annexure-III to this specification. 2. Motor characteristic curves
3.6.22	Inspection & testing	Vendor to submit Quality plan.

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NOTE: Motor shall conform to IS 325 and the additional specific requirements brought out above. If motors are of special design other than standard the same shall be witnessed during testing by Purchaser or its appointed representative (Type & Routine test).

3.7.0 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 110 V 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. Limit switches and 'Torque switches or thermal overload relay' shall be provided for 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.

3.8.0 CONTROL CABINET

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

3.8.2 TYPE: Wall mounting type. Normally mounted on a framework of the hoist. The cabinet shall be made of minimum 1.5-mm thick cold rolled sheet.

3.8.3 MOTOR PROTECTION: All motors shall be protected against under voltage, over load and short circuit condition.

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

3.8.5 CONTROL RELAYS: Shall be provided suitably wherever required.

3.8.6 INDICATING LAMPS: Shall be provided wherever required.

3.8.7 TERMINAL BLOCKS: Clip on type. Suitable for 1.5 sq mm copper conductor. 20 % of additional terminal blocks shall be supplied as spares along with the supply.

3.8.8 CUSTOMER SUPPLY VOLTAGE : 415V , 50 Hz, 3 Phase

3.8.9 CONTROL VOLTAGE : 110 V, 50 Hz, single phase.

3.8.10 ENCLOSURE PROTECTION : IP 55 as per IS 13947 (Part I). Weather protection type test certificate shall be furnished. Drawing showing constructional features of item subjected to weather protection test should form part of test certificate and drawing no. shall appear on TC.

3.8.11 GLANDS: Shall be double compression type. To be included in vendor scope as per requirement.

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3.8.12 INTERNAL WIRING:

1. PVC 650/ 1100 V Grade 1.5 sq.mm multi-strand/ copper conductor
2. All control power wiring with red and black.
3. All control wiring is to be with grey wire & shall be marked with ferules as per wiring diagram.

3.8.13 PAINTING: Exterior: Grey; Interior: Brilliant white – glossy finish with enamel paint. For special painting if any, refer annexure-II to this specification.

Exterior- 120 microns; Interior – 80 microns-minimum

3.8.14 DIMENSION: Vendor to specify. The dimensional drawing, internal layout, wiring drawing shall be submitted for approval prior to manufacture.

3.9 CONTROL BOX

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

3.9.2 LOCATION: Hanging from equipment.

3.9.3 PUSH BUTTON: For start green push button and for stop red push button shall be used. Make shall be of Siemens/ L&T/ EE. 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.

3.9.4 CONTROL VOLTAGE : 110 V AC 50 Hz Single Phase.

3.9.5 ENCLOSURE PROTECTION: IP 55 as per IS 13947 Part I. Weather protection type test certificate shall be furnished. Drawing showing constructional features of item subjected to weather protection test should form part of test certificate and drawing no. shall appear on TC.

3.9.6 BOX MATERIAL: Cold rolled sheet steel with 1.5-mm thickness minimum.

3.10.0 CABLING: Vendor shall include all the power and control cables necessary for the system. The cable shall comply with **IS 9968**. 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 armored of 1.5 sqmm 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.

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

3.12.0 For *the Approved Sub-Vendor/ Make List for Mechanical, Electrical & Control Items etc.* *Vendor shall refer to Specification No.BA73011/ rev.04:*

3.13 NAME PLATES:

3.13.1 Name plates shall be provided with non-corrosive material.

3.13.2 Name plates shall have details of the equipment, model no., type, capacity, lift, span, and motor & brake details.

3.13.3 All lubrication points shall be provided with name plates.

4.0 PAINTING, PROTECTION, PACKING, SUPPLY and IDENTIFCATION:

4.1 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.

4.2 PAINTING: 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. For special requirements, if any, refer annexure-II.

4.2.1 COLOUR SCHEME

4.2.1.1 Under hung crane	:	**Golden Yellow RAL No.1004**.
4.2.1.2 Trolley with hoist	:	**Golden Yellow RAL No.1004**
4.2.1.3 Interlock mechanism	:	Ash grey
4.2.1.4 DSL components	:	Ash grey
4.2.1.5 Hook	:	**Signal Red RAL No.3001**
4.2.1.6 Chain Pulley systems	:	**Golden Yellow RAL No.1004**
4.2.1.7 Identification Tag/Band	:	**White RAL9010**

4.3 All the dispatchable units shall be packed in a wooden case with water proof material.

4.4 The material shall be despatched with clear bill of material for each system.

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4.5 Each and every dispatchable item shall be identified with Item number, Purchase order reference number and tagged properly for easy identification.

5.0 INSPECTION AND TESTING:

5.1 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 as per approved QAP document.

5.2 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.

5.3 The Trolley with hoist shall be run 5 times at manufactures works. All the 5 runs shall be tested with 125% safe working load with out 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 50 mm only. Hook approach shall be checked as per approved drawing.

5.4 The brakes of 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. Maximum slip (braking path) shall be as per approved data sheet/ drawing.

5.5. 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 crane. Top limit switch/(torque switch or thermal overload relay) 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.

5.6 Over load relay 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.

5.7 Trolley with hoist and under hung crane gears shall be tested with & without load for alignments and smooth operation.

5.8 Equipment shall be tested for hoisting and cross travel with 125% SWL.

5.9 Hoisting and cross travel speed shall be tested and shall ensure the tolerance with in 10%. Hoisting and CT shall be tested for minimum 2.0 m (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.

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5.9.1 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.

5.9.2 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 Purchaser/ End User.

5.10. 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.

5.11 HOOKS

5.11.1 a) Raw material test certificate shall be submitted from manufacturer.
b) Chemical composition & physical properties shall be carried out on one sample per batch as per IS3815-1969 standard. Copy of TC to be produced.

5.11.2 Proof load test 200% of SWL on each hook irrespective of capacity.

5.11.3 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 ASME- Section –VIII Division.2 – AM 203.2/ ASTM E 446.

5.12.0 UNDER HUNG CRANE

5.12.1 Check the dimensions of the under hung crane as per relevant standard.

5.12.2 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 SWL at centre of span compared with this datum should be less than SPAN / 1000.

5.13 DOWN SHOP LEAD SYSTEM (DSL)

5.13.1 Cable trolley shall be tested for smooth running on "Tee" track with cable load.

5.13.2 Cable reel insulator shall be tested for smooth running on steel wire rope with cable load.

5.13.3. Any discrepancy found in the design and / or supply shall be resolved by Vendor at the installation (site) at Vendor's cost.

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5.14 ELECTRICAL COMPONENTS:

5.14.1 The insulation values of all electrical equipments should be checked. Reading shall be not less than 1.0 M Ω with an unregulated type tester with DC voltage not less than twice the rated voltage.

5.14.2 Control panel shall be verified for make, model no. and location of all relays & components as per the approved drawing.

5.14.3 Functional test shall be conducted for power and control circuits.

5.14.4 Test for high voltage and measurement of insulation resistance shall be conducted.

5.14.5 Degree of protection test report shall be submitted (type test report).

5.14.6 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 unfavorable conditions.

5.14.7 TC for control panel, pendant stations and motors shall be provided. Weather protection type test certificate shall be furnished. Drawing showing constructional features of item subjected to weather protection test should form part of test certificate and drawing no. shall appear on TC.

6.0 DOCUMENTS BY VENDOR

6.1 Documents along with the offer:

6.1.1 General arrangement, DSL & interlock mechanism (female & male) arrangement drawings 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.

6.1.2 Wiring circuit diagram with details of make, type and rating of all components.

6.1.3 Spares list for 3 years of trouble free operation along with price. Commissioning / Initial spares shall form part of the base offer.

6.1.4 Write up on special features if any.

6.1.5 Technical specification for equipment.
6.1.6 Catalogues and other details of the product shall be submitted along with the offer.

6.1.7. Deviation: Any deviation to specification shall be clearly spelt out in the offer itself. During Contract/ Delivery/ Installation Stages, no deviation will be entertained.

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6.1.9. 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.

7.0 DOCUMENTS AFTER PLACEMENT OF PURCHASE ORDER: (Three Sets)

7.1 Quality plan shall be submitted by vendor for Purchaser's approval

7.2 Dimensional drawings of Under Hung Crane, Trolley with Hoist, Down shop Leads, Cable trolley, control panel and wiring diagram with BOM for approval. Data Sheet for hoists and cranes for Purchaser/ End Users approval.

7.3 The following calculations/ details shall be furnished.

7.3.1 Hoist motors and Travel motor power calculations.

7.3.2 Brake Torque calculations and Brake selection for each hoist.

7.3.3. Main Hoist rope and wire rope selection.

7.3.4 Cross travel and long travel wheel load and wheel diameter calculations/ details.

7.3.5 Details/ Drawings of Gearboxes, Hooks, Couplings and Brakes etc.

7.4 Following test certificates shall be provided during supply.

7.4.1. Physical, Chemical, NDE and hardness test certificates shall be provided wherever applicable for trolley/ crane wheels, wire ropes, pulleys, hook, gears, pinions and shafts.

7.4.2. Test certificates for having carried out the tests as per clause 5.0 of this specification under Purchaser and End User's presence.

7.4.3 Test reports for wire rope and hooks.

7.4.4. Test reports for NDT examination of gears, wheels, pinions and hooks.

7.4.5 Type test and routine test certificates for motors and as per IS 325.

7.4.6 Performance test certificates for UHC, TWH, Safety devices and other electrical items.

7.4.7. TC for control panel, pendent stations and motors shall be provided. Weather protection type test certificate shall be furnished. Drawing showing constructional features of item subjected to weather protection test should form part of test certificate and the drawing number shall appear on TC.

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7.4.8. 5 sets of operation and maintenance manuals shall be provided with details for storage, installation, erection procedures, drawings, motor data sheet, operating and trouble shooting, lubrication schedule, spares data, spares identification drawings, spares replacement procedure and special requirements, if any. All copies are to be sent to BHEL/ Hyderabad

7.4.9. Soft copy with as build drawing files and O&M manual details for equipments under supply to be provided to Purchaser.

7.4.10. 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.

8.0. **DRAWINGS AND O&M MANUALS:**

8.1. The drawings furnished with the offer shall clearly indicate the items (bill of materials) that go to make the trolley with hoist, under hung crane, DSL system and interlock mechanism. The drawings shall clearly indicate the weight particulars of such items/ sub-assembly that will be despatched as loose items in packing cases.

8.2 The bill of material shown in the drawing shall match with that of the despatchable unit as indicated in the packing slip.

8.3 The drawing shall be prepared in AUTOCAD and vendor shall forward both hard copies (3 copies each) and soft copy (with drawing files) to the Purchaser.

8.4. **O&M MANUALS**

8.4.1. Number of copies required is 5.

8.4.2 Manuals should be in printed form only.

8.4.3 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.

8.4.4 Drawings shall be of printed or laser printed only.

8.4.5 Spiral or comb bound copies should be totally avoided.

8.4.6 If manuals are supplied in folders, the folder shall have 3 hole punching system.
8.4.7 O&M Manuals, shall be submitted to BHEL/ Hyderabad prior to despatch of the equipment.

8.4.8 Manual generally should contain the following:

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8.4.8.1 Data Sheet

8.4.8.2 Brief description.

8.4.8.3 Operation.

8.4.8.4 Maintenance (including lubrication, where necessary) and service, recommended spares for 2/3 years trouble free service.

8.4.8.5 Trouble Shooting.

8.4.8.6 Assembly drawings with part list, dimensional drawings & other applicable drawings.

8.4.9 Manuals should pertain only to the types or model supplied for the particular contract. Copies are to be sent to BHEL/ Hyderabad only.

9.0 GUARANTEE REQUIRED: 18 months from the date of commissioning or 24 months from the date of **supply.**

10.0 ERECTION, COMMISSIONING & HANDING OVER TO CUSTOMER.

The supplier shall depute experienced engineer to supervise erection & commissioning as well as load tests jobs of the handling system, being executed by BHEL site office Contractor personnel. Supplier shall ensure commissioning of the system to the satisfaction of the customer. Customer certificate to this effect is to be submitted to BHEL, after completion of the work. Supplier representative may have to stay at site for about 15 days per unit in 3 to 4 spells. Delays due to issues at supplier end will not considered in above 15 days.

11.VENDOR SHALL SUBMIT ALL THE PART DRAWINGS ALONG WITH TECHNICAL OFFER.

VAR. NO.	DESCRIPTION	MATERIAL CODE	WEIGHT KG's
00	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 623 x 4 MILLS	BA9755039007	8, 000
01	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 763-803 x 6 MILLS.	BA9755039015	14, 800
02	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 763-803 x 5 MILLS.	BA9755039023	13, 200
03	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 883-943 x 7 MILLS.	BA9755039031	24, 300
04	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 883-943 x 6 MILLS.	BA9755039040	19, 350
05	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 1003 x 10 MILLS.	BA9755039058	44, 300
06	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 1003 x 7 MILLS.	BA9755039066	35, 700
07	ELECTRICAL OPERATED HANDLING EQUIPMENTS BBD 4760/4772 x 3 MILLS.	BA9755039074	2300
08	ELECTRICAL OPERATED HANDLING EQUIP. XRP 883-943 x 6 MILLS WITH PGB.	BA9755039082	22, 000
09	ELECTRICAL OPERATED HANDLING EQUIPMENT BBD3448 x 2 MILLS	BA9755039090	18,000
10	ELECTRICAL OPERATED HANDLING EQUIPMENT XRP 1003 x 9 MILLS WITH PGB.	BA9755039104	43, 000
11	ELECTRICAL OPERATED HANDLING EQUIPMENT BBD4760 x 3 MILLS	BA9755039112	22,000

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VAR. NO.	DESCRIPTION	MATERIAL CODE	WEIGHT KG's
12	ELECTRICAL OPERATED HANDLING EQUIPMENT- 8 x XRP1003	BA9755039120	38600
13	ELECTRICAL OPERATED HANDLING EQUIPMENT XRP 883-943 x 5 MILLS WITH PGB.	BA9755039139	20,000
14	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 763-803 x 4 MILLS (HHP).	BA9755039147	13, 500
15	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 763-803 x 6 MILLS (HHP)	BA9755039155	17,000
16	MODIFIED MILL HANDLING EQUIPMENTS XRP 1003x10 MILLS-DTC	BA9755039163	41,000
17	MODIFIED MILL HANDLING EQUIPMENTS XRP 1003x8 MILLS-DTC	BA9755039171	33,000
18	MODIFIED MILL HANDLING EQUIPMENTS XRP 1003x6 MILLS-DTC	BA9755039180	28,500
19	MODIFIED MILL HANDLING EQUIPMENTS XRP 1043-1103x8 MILLS-DTC WITH PGB	BA9755039198	47,000
20	MODIFIED MILL HANDLING EQUIPMENTS XRP 1043-1103x9 MILLS-DTC WITH PGB	BA9755039236	49,500
21	GOLIATH CRANE-9M SPAN-5T CAPACIT	BA9755039201	5,500
22	MODIFIED MILL HANDLING EQUIPMENTS HP 1103 MILLSx9 MILLS	BA9755039210	47,500
23	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 763-803 x 5 MILLS (HHP).	BA9755039228	15, 500
24	ELECTRICAL OPERATED HANDLING EQUIPMENTS HP 763-803 x 5 MILLS	BA9755039244	17, 500
25	TROLLEY WITH HOIST -5Tons ELECTRICAL OPERATED	BA9755039252	1,000

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VAR. NO.	DESCRIPTION	MATERIAL CODE	WEIGHT KG's
26	ELECTRICAL OPERATED HANDLING EQUIP. XRP 883-943 x 6 MILLS WITH PGB+8MC.	BA9755039260	25, 000
27	ELECTRICAL OPERATED HANDLING EQUIP. XRP 883-943 x 7 MILLS WITH PGB	BA9755039279	28, 000
28	ELECTRICAL OPERATED HANDLING EQUIPMENTS XRP 703-803 x 5 MILLS (WGB).	BA9755039287	13, 200
29	MODIFIED MILL HANDLING EQUIPMENTS HP 1103 MILLSx7 MILLS	BA9755039XXX	42,000
30	MODIFIED MILL HANDLING EQUIPMENTS HP 1103 MILLSx8 MILLS	BA9755039XXX	45,000
31	MODIFIED MILL HANDLING EQUIPMENTS HP 1103 MILLSx7 MILLS WITH DYNAMIC CLASSIFIER	BA9755039XXX	43,000
32	MODIFIED MILL HANDLING EQUIPMENTS HP 1103 MILLSx9 MILLS WITH DYNAMIC CLASSIFIER	BA9755039XXX	48,500
33	EL.OP MILL HND EQP HP 1103 BMPGB-7MILL	BA9755039333	42000
34	MLL HANDLING SYSTEM- 8MILLS HP 1103	BA9755039341	47000
35	MILL HAND. EQ. XRP-1043-1103X8 MILL	BA9755039350	47000
36	MLL HAND.SYS.-8MILLS HP1103(12.8M BAY)	BA9755039368	47000
37	MLL HAND.SYS.-9 MILLS XRP 1043	BA9755039376	46000
38	EL.OP MILL HND EQP HP 1103-7MILL DC	BA9755039384	42000
39	MOD.MILLHAND.EQ.XRP-1043-1103X7 MILL	BA9755039392	45000
40	EL.OP MILL HND EQP HP 1103 BMPGB-7MILL	BA9755039406	42000
41	MLL HAND.SYS. 7 MILLS HP1103	BA9755039414	45000
42	MLL HAND.SYS. 9 MILLS HP1203	BA9755039422	50000
43	EL OP MILL HND EQP XRP 703 BM WGB-4MILL	BA9755039430	13200
44	EL.OP MILL HND EQP HP 1103-9 MILLS	BA9755039449	45000
45	EL.OP.MLL HAND.SYSTEM 8 MILLS- HP1203	BA9755039457	38000
46	EL.OP.MLL HAND.SYSTEM 8 MILLS- HP1103	BA9755039465	30000
47	EL.OP.MLL HAND.SYSTEM 9 MILLS- HP1203	BA9755039473	40000
48	EL.OP.MLL HAND.SYSTEM 6 MILLS- XRP1003	BA9755039481	33000
49	EL.OP.MLL HAND.SYSTEM 8 MILLS- HP1103	BA9755039490	33000
50	EL.OP MILL HND EQP XRP883 -6 MILLS	BA9755039503	28000
51	EL.OP.MLL HAND.SYSTEM 8 MILLS- HP1103		33000

RECORD OF REVISIONS

REV	DATE	REVISION DETAILS	REVISED	APPROVED

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NO				
01	23.04.04	VARIANTS ADDED IN PAGE 20 OF 21	M.V.R.MURTHY	JGK
02	05.05.05	UPDATED SPEC. WITH ADDITIONAL INFORMATION	M.V.R.MURTHY	JGK
03	07.11.05	THE WEIGHTS ARE CORRECTED. VARIANT NO.08 ADDED.	M.V.R.MURTHY	JGK
04	11.12.06	VARIANT NO: 09 ADDED IN PAGE 19	N.D.SAMUEL	T.M.RAO
05	16.04.07	VARIANT NO: 10 ADDED IN PAGE 19	M.V.R.MURTHY	JGK
06	24.07.07	VARIANT NO: 11 ADDED IN PAGE 19	NDS	TMR
07	17.10.07	VARIANT NO: 12 ADDED IN PAGE 19	AMAN	MVRM
08	25.02.08	VARIANT NO: 13 & 14 ADDED IN PAGE 19	AMAN	MVRM
09	26.03.08	VARIENT NO.15, 16, 17, 18 & 19 ADDED IN PAGE 20	AMAN	MVRM
10	15.04.09	VARIENT NO.20, 21 & 22 ADDED IN PAGE 20. UPDATED SPEC. WITH ADDITIONAL INFORMATION	AMAN	MVRM
11	21.05.11	VARIENT NO.23 TO 33 ADDED IN PAGE 20/ 21. UPDATED SPEC. WITH ADDITIONAL INFORMATION	AMAN	MVRM
12.	25.09.11	BASED ON VENDORS FEEDBACK CLAUSE NO1.0 (SCOPE),3.1.8 (BRAKES),3.1.15(PLATFORM),3.7.0(CONTROLS/INTERLOCKS)&5.5 REVISED	ATUL	MVRM
13	12.08.17	New material codes are added	PVSB	S GHTGE

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