

TECHNICAL PROCUREMENT SPECIFICATION	BARGE UNLOADER CONTROL	CD-BUCS-TPS-MS			
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<p>1.0 INTRODUCTION</p> <p>1.1. This specification covers the requirements of Control System for Barge Unloader for FACT Cochin Division.</p> <p>2.0 SCOPE OF WORK</p> <p>2.1. The Scope of work shall include detailed engineering, design, manufacturing, testing at works, inspection, supply, transportation, commissioning, trial runs and handing over of Control panels and related accessories for BARGE UNLOADING SYSTEM, including but not limited to the following such as switch board (MCC), earthing, installation materials, acceptance test at site etc. required for safe and successful completion of the job. Imparting training to engineers and technicians (4 persons) for maintenance and configuration of system is also under vendor's scope.</p> <p>3.0 GENERAL REQUIREMENTS OF CONTROL SYSTEM</p> <p>3.1. The electrics of Barge Unloader shall include Switch Dis-connector Fuse (SDF) / MCCB, Motor Control Panels, VFDs, PLC (if required in control scheme), Braking Resistors (please note point below), Selector Switches, Push Buttons, Indication Lamps, Lighting Distribution Panel and lighting fixtures with lamps, HMI, terminal connectors, Power/ Control/ Auxiliary Contactors, HRC/ Thyristor/ Semiconductor fuses, socket outlets etc. as required. Vendor need not supply motors and thruster brakes.</p> <p>3.2. The existing system employs a braking resistor of 100 kW for both closing and holding motors and the vendor need not supply new braking resistor if Vendor's design requirement is met with it.</p> <p>3.3. All cabling and wiring such as power, control and earth cables/ earth conductors and cabling accessories shall be terminated inside the control panel. All cables shall conform to IS 1554 or latest requirements. Power and control cables shall be of 1.1 kV grade with copper conductor. Cable entry points shall be completely sealed using appropriate barriers/ compounds.</p> <p>3.4. All equipment shall be of robust construction. Electrical equipment shall be adequately rated to permit simultaneous operation of any combination of motions of the unloader for its duty service. In general, the control voltage to be 110V AC, single phase, 50Hz. All cables to have bottom entry into panels. Power and control terminals to be grouped separately with 20% extra terminals in each group.</p> <p>3.5. Interlock/ logic controls shall be either using PLC or drive I/Os. If PLC is used for communication between PLC and VFDs, it shall be through communication bus. PLC/ Drive provided shall have 20% spare I/O capacity.</p>					
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3.6.	Panels shall be any one of make specified in approved makers list. Panels, controllers, resistors etc. are to be properly marked for each motion. Indication lamps shall be clustered LED type. Sufficient lighting shall be provided inside panels with suitable door switch.				
3.7.	Motors which are not using VFD drives like thruster motors shall be started on DOL. Vendor should provide sufficient control scheme and LV switchgear including contactor, overload and Single phase preventer for controlling brake thruster motors.				
3.8.	VFD drives and control panels should be provided for Hold/ Hoisting, Close, Long and Cross travel motions. Speed and position controls shall be state-of-the-art Vector control or superior technology. Hold/ Hoisting and closing drive control shall be closed-loop type with pulse encoder feedback. Present motors have 'Hubner' Pulse Encoder coupled to motor shaft and Vendor should supply new encoder if Vendor's system does not support existing encoder.				
3.9.	All panels accommodating VFD, PLC etc. and other controls should be erected in the ground level room. Separate cubicles shall be used for PLC and drives.				
3.10.	VFDs shall be selected with appropriate de-rating for the cyclic start/ crane duty operation/ overload tolerance as required for the unloader.				
3.11.	VFDs shall be fully digital, Micro Processor based with switching devices for inverter as IGBT or any superior power electronic device. It shall have USB Interface to connect to Laptop/ PC for communication and diagnosis, parameter setting through Control pad/ PC. Forced cooling method shall be adopted. Input reactor shall be provided with all VFDs. Output reactor shall be provided as per site requirement. The VFD shall operate without any deterioration in performance over (+/-) 5% of rated 3-phase supply (415 V) and over (+/-) 2.5 % of rated frequency (50 Hz) mentioned in this specification.				
3.12.	VFDs shall have the following protections as a minimum. Values in brackets are preferred ranges.				
	<ul style="list-style-type: none"> i. Current supervision (50 -200% rated current) ii. Rapid current limitation (to 200% rated current) iii. Current switch off (300% Instantaneous) iv. Input phase loss/ input phase imbalance protection v. Output phase loss with lost phase identification vi. Output short circuit protection vii. Ground Fault viii. Over temperature ix. Over/ under voltage trip x. Motor Stall (30 -200% of rated inverter current) xi. Motor overload/ over torque 				
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<p>xii. Parameter locking</p> <p>3.13. VFDs shall have front-mounted operator control panel consisting of LCD display with plain English text and a keypad with keys suitable for parameterization and menu navigation. The display shall be suitable to show parameter and its value in single screen and shall show stop/ start controls, program/ drive mode selection, set parameters, reference settings, actual values, faults, fault history, alarms, motor kW, current, speed, torque, O/P frequency, DC bus voltage, heat sink temperature etc. VFD keypad shall be capable of storing drive parameter values in non-volatile memory. If memory is separate, vendor to give details in technical bid.</p> <p>3.14. The VFDs shall be provided with line-side harmonic reduction to restrict current distortion within limits as per the standards. Suitable internal DC link reactors/ line-side reactors shall be provided to minimize power line harmonics and to provide near unity power factor. Output current THD shall be less than 5% as per IEEE519 guidelines. Standard induction motors shall not be required to be de-rated or up-graded for turn-to-turn insulation and shall not require additional service factor. The motor insulation system shall not be compromised thermally or due to dv/dt stress. Filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50V DC within 30 seconds after the loss of AC voltage. All capacitors shall be maintenance- free and self-healing type.</p> <p>3.15. Motor Cable Distance - The VFD shall provide stable operation of the motor without compromising motor insulation, regardless of motor cable distance upto 150 meter, with or without output choke. Vendor shall clearly state the limitations related to motor cable distance. Output filter, if any, required for cable distance limitation mentioned, to mitigate reflected waves or to meet any special requirements of the application shall be integral to the VFD. If output filters are used in the variable frequency drive, a selective harmonic elimination switching technique shall be available to eliminate the potential harmonic resonance in the operating speed range.</p> <p>3.16. VFD Cooling System shall be Air-cooled with single/ mixed flow fans having quiet operation, mounted integral to the VFD enclosure. Air flow switches/ temperature detectors to be provided to monitor cooling system. Alarm indication for fan-failure shall be provided.</p> <p>3.17. All VFD motors shall be provided with electric braking using braking resistors. Braking resistors shall be located adjacent to the ground level panel room.</p> <p>3.18. Power supply to brakes shall be tapped from VFD drive supply. However, fail-safe design shall be ensured.</p> <p>3.19. Clearance of the panels shall conform to Indian Electricity Rules.</p>					
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<p>3.20. The scope shall also include providing a pre-start audio warning signal through hooters in the premises where the mechanisms are to be started before start of the unloader. The duration of the pre-start audio signal shall be as per the set time in the timer. Sequential start of the mechanism shall be possible only after the pre-start audio signal is over.</p> <p>3.21. Installation of panels/ equipment, cable termination and connection, sealing of cable entry points with suitable barriers/ seals shall be in Vendor's scope.</p> <p>3.22. Power cables shall be 1.1kV grade armoured PVC or XLPE cables. Power cable sizing shall be appropriate and the minimum size shall be 4 sqmm, multi-stranded Copper. All control cables shall be 2.5 sqmm.</p> <p>3.23. All flexible cables shall be multi-stranded Copper. Single stranded cable shall not be used anywhere inside the unloader.</p> <p>3.24. Specification, make and layout of all major bought-out components are to be got approved by the Purchaser before panel fabrication.</p> <p>3.25. Joy-stick Control shall be step-less for continuous variation in speed/ position.</p> <p>3.26. The hoisting of the grab shall be possible while grab-closing is in progress. The closing motor shall run at higher speed and make the grab closed. Rope tension during hoist/ lower/ close/ open during all combination of operations shall be taken care by the Control System.</p> <p>3.27. Slack rope control facility shall be provided.</p> <p>3.28. HMI module with size not less than 6 X 6 inch shall be provided in control panel, which shall display current status of input interlocks, output etc. In case of absence of any interlock inhibit operation of crane shall be displayed in HMI in an alarm screen and history of same shall be accessible from HMI</p> <p>3.29. Indication for open, close, ready-for-start and trip shall be given in operator console.</p> <p>3.30. There shall be provision to save open and close position of grab by selecting setting mode in operator console. When setting mode is activated, hold and close motor should be operated very slow.</p> <p>3.31. Field interlocks like limit switches shall not be connected to Drive/ PLC directly. Vendor shall provide intermediate relays for proper isolation of circuit.</p> <p>3.32. All control cables shall be terminated inside control panel using proper connectors. Labels of permanent nature should be provided on supports of all switches, fuses, motors, brakes, contactors, relays etc. to facilitate identification of circuits and replacement. All power,</p>					
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<p>control, lighting and other cables are to be tagged at both ends as per cable number indicated in the Supplier's drawing. All equipment terminals are also to be marked likewise. Cable core should be provided with proper ferule number as approved by the Purchaser.</p> <p>3.33. All electrical items offered shall be suitable for tropical and humid climate and shall be dust and vermin proof.</p> <p>4.0 STANDARDS AND REGULATIONS</p> <p>4.1. Electrics of the crane shall comply with the Indian Electricity Rules, Regulations, Acts, statutory regulations applicable for the place of installation and shall conform to the latest edition of relevant Indian Standards particularly the following:</p> <ul style="list-style-type: none"> i. IS:3177 Code of practice for electrics of overhead traveling crane ii. IS:8544 Motor starters for voltages not exceeding 1000 V <p>5.0 DRAWING AND DOCUMENTS</p> <p>5.1. Vendor shall prepare and submit documents, drawings etc. as specified in Vendor data requirement, for Purchaser's approval according to Vendor's data submission procedure.</p> <p>6.0 DETAILS OF EXISTING SYSTEM</p> <p>6.1 Existing Motors that need to be controlled</p> <p>With VFD</p> <ul style="list-style-type: none"> i. Hold Motor: 55 kW, 1485 rpm ii. Close Motor: 55 kW, 1485 rpm iii. Long Travel Motor: 15 kW, 1470 rpm iv. Cross Travel Motor: 2.5 kW, 1435 rpm <p>Note: Long travel and cross travel motors do not necessarily need simultaneous operation and hence, the Vendor can use single drive to control both, if control scheme supports this and multi-motor parameter setting feature available in VFD.</p> <p>By DOL Starter</p> <ul style="list-style-type: none"> i. 4 numbers of Brake thruster: 0.25 kW 					
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6.2. List of existing interlocks that need to be incorporated in the new Control Scheme

1.	Start PB on Control Desk	:	NO
2.	Emergency Stop	:	NC
3.	Start PB on RRC	:	NO
4.	Alarm PB on RRC	:	NO
5.	Neutral Position of M/C RS	:	NC
6.	Control from M/C	:	NC
7.	Control from RRC	:	NC
8.	UP Slow Rotary L/S	:	NC
9.	UP Stop Rotary L/S	:	NC
10.	DOWN Slow Rotary L/S	:	NC
11.	DOWN Stop Rotary L/S	:	NC
12.	UP/DOWN input from Joy stick (M/C)	:	Analog (-) 10 to (+) 10
13.	UP/DOWN input from Joy stick (RRC)	:	Analog (-) 10 to (+) 10
14.	Grab fully OPEN SAVE PB	:	NO
15.	Grab fully CLOSE SAVE PB	:	NO
16.	Grab adjustment mode	:	NO
17.	Grab Normal operation mode	:	NC
18.	Grab OPEN from M/C	:	NO
19.	Grab CLOSE from M/C	:	NO
20.	Grab OPEN from RRC	:	NO
21.	Grab CLOSE from RRC	:	NO
22.	CT Forward SLOW L/S (Hopper side)	:	NC
23.	CT Forward STOP L/S	:	NC
24.	CT Reverse SLOW L/S (River side)	:	NC
25.	CT Reverse STOP L/S	:	NC
26.	CT input from Joy stick (M/C)	:	Analog (-) 10 to (+) 10
27.	CT input from Joy stick (RRC)	:	Analog (-) 10 to (+) 10
28.	LT Land-side Slow Down L/S	:	NC
29.	LT Land-side STOP L/S	:	NC
30.	LT Water-side Slow Down L/S	:	NC
31.	LT Water-side STOP L/S	:	NC

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32.	LT input from Joy stick (M/C)	:	Analog (-) 10 to (+) 10
33.	LT input from Joy stick (RRC)	:	Analog (-) 10 to (+) 10
34.	Slack rope enable selection	:	NO
35.	Neutral Position of M/C LS	:	NO
36.	Safety trip rotary L/S	:	NC
37.	LT Trolley Safety interlock	:	NC

6.3. List of existing Outputs that need to be incorporated in the new Control Scheme

1.	Control ON Indication	:	NO
2.	Control Trip Indication	:	NO
3.	Control from M/C Indication	:	NO
4.	Control from RRC Indication	:	NO
5.	Alarm ON	:	NO
6.	Light ON	:	NO
7.	Fault Indication	:	NO
8.	Emergency Stop of RRC Bypass in M/C Mode	:	NO
9.	Cross Travel	:	NO
10.	Long Travel	:	NO
11.	Grab Open Indication	:	NO
12.	Grab Close Indication	:	NO

6.4. List of Functions/ Grab Technology as Existing and shall be retained in the new Control Scheme

A. Holding Gear

- Non-linear Master Controller Set Point

The sensor fitted to the Master Controller supplies a set point which is directly proportional to its angle of excursion. To allow the Crane Operator to make more accurate positioning at slow speeds, the set point follows a nonlinear function, and the output characteristic is thus converted into a progressively bent characteristic. This permits fine adjustment even at small speeds.

- Heavy-duty Operation

In heavy-duty operation, loads greater than the rated load can occasionally be lifted. However, this is only permissible at reduced speed. In this mode, therefore, the master

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controller set point is multiplied by a selectable factor of less than 1 (< 1). This results in full utilization of the excursion area with reduced presetting of the set point.

- Position/ Displacement Control

Using Position Control, the drive can approach a preset point with Displacement Control and time optimization. From a specified point onwards, the speed set point is limited according to the displacement. The displacement actual value is available via a Pulse Generator.

- Pre-limit Switching

The function "Pre-limit switching" permits limitation of the speed set point to an adjustable speed when the pre-limit switch is run-over. This prevents the drive from moving at full speed into the limit switch.

- Inching Operation

For inching, an adjustable jogging set point is applied as the speed set point in order to define small speeds e.g. for cable changing

- Starting Pulse

To prevent sagging of the load, a constant or load dependent set point is applied to the Pre-control input of the Speed Controller in the hoisting winch.

- Changeover of Ramp Function Generator with Field Weakening and heavy-duty service

At the transition into the field weakening region, the ramp-up time can be extended to prevent moderately rated drives from reaching the current limits. In heavy-duty service, however, the ramp-up time is extended from the beginning, compared to the rated ramp-up time, and not only when a particular speed is reached.

- Speed Zero Signal

Speed zero detection for brake control at speeds between 5 and 10 % of rated speed.

- Control Monitoring

This function carries out a comparison between speed set point and actual value.

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<ul style="list-style-type: none"> ○ Monitoring of Speed Actual Value <p>In actual value monitoring, a prerequisite is the presence of two speed actual value generators, for example, a normal speed actual value generator and a displacement actual value generator (which also supplies a speed). With hoisting winches, a generator can be fitted at the motor and a generator at the drum. This allows monitoring of the mechanical elements between them (gear breakage monitoring).</p> ○ Constant Field Weakening <p>With hoisting winches without load measurement, the speed during lowering can be increased by the square of the efficiency.</p> ○ Slack Cable Control <p>The Slack Cable Controller can be used to prevent the cable from becoming slack when the grab is closed in the load material. It also ensures that the grab can dig into filling material, thus achieving the maximum degree of filling.</p> <p>B. Closing Gear</p> <ul style="list-style-type: none"> ○ Inching Operation <p>For inching, an adjustable jogging set point is applied as the speed set point in order to define small speeds, e.g. for cable changing.</p> ○ Starting Pulse <p>To prevent sagging of the load, a constant or load dependent set point is applied to the pre-control input of the speed controller in the hoisting winch.</p> ○ Speed Zero Signal <p>Speed zero detection for brake control at speeds between 5 and 10 % of rated speed.</p> ○ Control Monitoring <p>This function carries out a comparison between speed set point and actual value.</p> ○ Monitoring of Speed Actual Value <p>In actual value monitoring, a prerequisite is the presence of two speed actual value generators, for example, a normal speed actual value generator and a displacement actual value generator (which also supplies a speed). With hoisting winches, a generator</p> 					
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can be fitted at the motor and a generator at the drum. This allows monitoring of the mechanical elements between them (gear breakage monitoring).

- Grab Displacement Control

With grab displacement control, the set point formed by the Position Controller is limited via the Master Controller of the closing winch. To adjust the grab during grab change, a small set point is applied via the Master Controller.

- Grab Adjustment

To adjust the grab, the displacement actual values are stored as set points for the "Opened" and "Closed" end points.

- Synchro Control for Lifting Beam Operation

During lifting beam operation of the holding and closing winch, the closing winch follows the holding winch with displacement control.

- Current Compensation Control

During hoisting and lowering of the closed grab, the tensions of the holding and closing cables should be approximately the same. The required hoisting power is optimally distributed over both motors. The current actual values are compared in the current compensation control, and the difference applied to the speed controller of the closing winch.

- Cactus Grab Operation

In cactus grab operation, the grabs usually require greater tension at the closing cable than at the holding cable. A supplementary circuit in the current equalization controller allows the current to be distributed asymmetrically in the desired ratio. A prerequisite is a corresponding motor design

C. Information needs to be displayed in Panel HMI

- Crane Operational Data

- i. PP feeder status (On/ Off)
- ii. Status of all Limit switches
- iii. Status of all Safety switches
- iv. Field devices on crane
- v. All Commands from Operator Control Desk

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<ul style="list-style-type: none"> ○ Status of Drives <ul style="list-style-type: none"> i. All voltages, currents, speed, displacement (Hoisting height/ travel distance) ii. Switchgear status of all drives ○ Online trends of all Digital (Boolean) & Analog (words) Signals ○ Current log of Fault & Alarm (All Faults & Alarms in clear English display) 					
<p>7.0 GENERAL REQUIRMENTS</p>					
<p>7.1. Panel</p>					
<p>7.1.1. All panels shall be of free-standing, floor-mounting construction, suitable to withstand vibrations encountered on crane.</p>					
<p>7.1.2. Hinged doors shall be provided for panels and shall be front wired.</p>					
<p>7.1.3. Front wired live points of bottom most equipment shall be mounted at least 350 mm above the bottom cover of the panel.</p>					
<p>7.1.4. Power and control terminals shall be segregated. 20% spare terminals shall be provided in each panel.</p>					
<p>7.1.5. Equipment in the panel shall be so mounted that their removal or replacement from the front is easy.</p>					
<p>7.1.6. There shall be item designation tags for each item inside each panel. These shall be placed at a convenient place near irremovable portion of the panel as well as on the body of the item. Equipment designation tags on the fixed portion shall be on Acrylic plate and names shall be embossed. On the item body, the designation tags shall be on printed stickers.</p>					
<p>7.1.7. Each panel shall be provided with suitable Forced air cooling arrangement using fans.</p>					
<p>7.1.8. Panels shall have bottom cable entry.</p>					
<p>7.2. Input Power Supply for New Panel</p>					
<p>7.2.1. FACT will give Power supply (AC: 415 V, 3-phase, 50 Hz) with adequate rating near the panel. Vendor shall terminate this cable in the panel and derive all other supplies required for satisfactory operation of panel.</p>					
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7.3. Software and License

7.3.1. Vendor shall provide suitable Software with lifetime license for configuration and monitoring of PLC Drive and HMI device. Scope of supply of suitable USB cable also is in Vendor's scope.

7.4. Emergency Stop Push Buttons

7.4.1. Existing Safety switches of sustained contact type provided in Operator Cabin, ground and Electrical room shall be incorporated in new Control Scheme so that under any emergency conditions, operating any one of the switches shall make the main incoming Contactor (already existing) tripped and thus cutting off power to all the motors and devices.

7.5. Earthing

7.5.1. All electrical accessories shall be effectively earthed in duplicate as per IS 3043 by the Vendor, to the nearest existing earthing junction plate provided by the Purchaser. Minimum size of earthing cable shall be 10 sqmm Copper or 16 sqmm Aluminium.

7.6. Resistances

7.6.1. The resistances, shall be designed as per relevant Indian Standard and shall be air cooled, rustproof, unbreakable grip type.

7.6.2. It shall be rated for minimum 10 minutes and suitable for operation in conjunction with drum controllers

7.6.3. It shall be mounted in a separate sheet steel housing with ventilated side covers. The resistor grid shall be cast iron/ stainless steel/ Ferro-chrome AL alloy.

7.6.4. The details of resistances and number of steps for cutting the resistances shall be furnished.

7.7. Controls and Protection

7.7.1. The crane hoisting, lowering, grab close, grab open and neutral position commands are generated by an 'H'-type analog Joystick. Crane long travel and cross travel motions are controlled by an analog '+'-type Joystick. Vendor shall incorporate both these controls in newly designed Control System. Supply of joystick is not in Vendor's scope.

7.7.2. Thyristor/ semiconductor fuse for Drives

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7.8. Panel for DOL Starters

7.8.1. The panel for accommodating DOL Starters (for non-VFD motors) shall include but not limited to the following:

- i. Main Contactor for individual motors
- ii. Isolating switches for individual motors
- iii. Triple-pole time-lagged thermal overload relays for individual motors with single phasing protection
- iv. HRC fuses for individual motor circuits and control circuit
- v. Control supply transformer with fuses on both sides.
- vi. Plug and socket for connection to hand lamp (240V AC)
- vii. Anti-condensation heater for panel, rated for 240V, single phase AC supply.
- viii. Control switches for anti-condensation heaters of motors and panel.

7.8.2. All reversing Contactors shall be electrically and mechanically interlocked.

7.8.3. All electrics used for thruster motor control shall be suitable for inching duty.

7.9. List of Acceptable Makes for Devices/ Components

7.9.1. The make of Devices/ Components used shall be as per the list furnished below. Make of items not included in the list shall be subject to approval by FACT.

1.	VVVF Drive	:	ABB, BHEL, Siemens, L&T, Yaskawa, SSD, Jeltron (Toshiba), Allen Bradley, Schneider, Rockwell, Fuji
2.	Programmable Logic Controller	:	ABB, BHEL, Siemens, L&T (Yaskawa), SSD, Jeltron (Toshiba), Allen Bradley, Schneider, Rockwell, Fuji
3.	MCB/ MCCB/ MPCB	:	Schneider, L&T, Andrew Yule, ABB, Siemens, BCH (BIL), GE Power Control, Moeller, Controls & Switchgear, Rockwell Automation, Standard, Indo Asian, MDS (Legrand), Fuji
4.	Switch Fuse Unit/ Switch Dis-connector Fuse	:	L&T, ABB, Siemens, GE Power Control, Controls & Switchgear, Fuji
5.	Power Contactor	:	Schneider, L&T, Andrew Yule, ABB, Siemens, BCH (BIL), GE Power Control, Moeller, Controls & Switchgear, Rockwell Automation, Standard, Indo Asian, MDS (Legrand), Fuji

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6.	Control/ Auxiliary Contactor	:	OEN, L&T, Schneider, ABB, Andrew Yule, GE Power Control, BCH (BIL), Easun Reyrolle, Siemens, Rockwell Automation, Controls & Switchgear,Fuji
7.	Electronic Overload Relay	:	Siemens, L&T, ABB, Rockwell Automation, Moeller, BCH, Schneider,Fuji
8.	HRC Fuse/ Semiconductor	:	GE Power Control, L&T, Siemens, Bharat Fuji , Indo Asian, Havells, Standard, Fuse Bussman, Controls & Switch Gear, ABB,
9.	Switched Mode Power Supply (SMPS)	:	Siemens, IFM, Rockwell Automation, BHEL, Schneider, Honey Well,Fuji.

8.0 EXECUTION

8.1. Erection of Panel, Fixing of Devices and Components

8.1.1. Physical erection of various panels will be under the scope of FACT. However, the scope of fixing of various components and devices inside the panel, if supplied separately, shall be under the scope of the Vendor.

8.1.2. All cable laying works from the field, if required, will be done by FACT. All field cables/wires will be properly identified by FACT so as to enable the Vendor to terminate/connect inside the panel suitably. All internal wiring/ interconnection etc. inside the panel shall be under the scope of the Vendor.

8.1.3. All the works which are not specifically mentioned in the scope of FACT shall be executed by the Vendor.

9.0 TESTING AND COMMISSIONING

9.1. Testing of the System, after installation of panels and associated controls, shall be carried out by authorized and trained personnel of the Vendor. Necessary support and assistance, especially for integration of the new Control System with the existing unloading equipment, will be extended by FACT's Engineer in-charge.

9.2. Testing shall include carrying out pre-commissioning checks on Power/ Control wiring, checking of Protection, Alarm and Annunciation, Earthing etc.

9.3. The following tests shall be conducted and records submitted to FACT.

- i. Insulation resistance of electrics supplied
- ii. Tests for Controls and Interlocks

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<p>iii. Physical verification of items for compliance with PO Specifications</p> <p>iv. Performance test at site by actual unloading of material. A minimum unloading speed of 250 MT/ hour shall be possible, without any limitation from the new Control System.</p> <p>9.4. System shall be deemed to be commissioned only after successful testing of various controls as specified in the TPS, checking of unloading operation for proper operation and handing over of the System to FACT.</p> <p>10.0 TRAINING</p> <p>10.1. After successful Commissioning of the System, the Vendor shall provide sufficient training to Technicians and Engineers of FACT. The level of the training shall be such that they shall be able to troubleshoot hardware/ software problems/ replace faulty devices/ cards and configure/ re-program after replacement of items.</p> <p>11.0 OTHERS</p> <p>11.1. Vendor shall provide minimum 1-year performance warranty from the date of commissioning for the New Control System (including all devices/ components) supplied by him.</p> <p>11.2. Vendor shall quote for 2 year on-call basis annual maintenance contract from the date of expiration of warranty. This AMC is for maintenance of the System including Configuration/ Program support. Spare for replacement will not be Vendor's responsibility. Recommended preventive maintenance has to be completed quarterly Payment will be made on quarterly basis on completion of each quarterly preventive maintenance service & receipt of invoice along with signed service report at our end. Vendor needs to attend breakdown calls within 24Hrs from registration of complaint.</p> <p>11.3. Vendor shall supply the panel within a period of 120 days from the date of issue of purchase order. The time taken by FACT, for approval of drawings and documents submitted by the Vendor shall be deducted for the purpose of finding the actual time taken by the Vendor for supplying panel. After erection of panel by separate contract arranged by FACT(under supervision of vendor) vendor have to commission panel within 30 days from the date of issue of clearance.</p> <p>11.4. FACT's general terms & conditions are applicable to this work.</p> <p>11.5. After completion of work at site, bidder shall prepare "AS BUILT DRAWINGS" and "O&M Manual" and submit to FACT.</p>					
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