


**400 MW Marib Gas Turbine Power Station Phase-II,
Yemen**

**TECHNICAL SPECIFICATION FOR 60/16/10 T
(DOUBLE GIRDER) EOT CRANE FOR GT HALL**

SPECIFICATION NO.: PE-TS-372-501-A001



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA
INDIA**

	TECHNICAL SPECIFICATION FOR DOUBLE GIRDER 60/16/10 T EOT CRANE 400 MW GTPS	Specification no.: PE-TS-372-501-A001
		Rev. 00
		Date: 04.02.13
		Sheet 1 of 2

INDEX

S.N.	VOLUME	SECTION	DESCRIPTION	PAGES
1.0	Volume II B	Section-A	Scope of Enquiry	2
2.0	Volume II B	Section-B	Project Information	5
3.0	Volume II B	Section-C	Specific Technical Requirement	11
4.0	Volume II B	Section-C	Procedure No. PEM (Q) / 01 – Gear Box Qualifying Criteria	4
5.0	Volume II B	Section-C	Annexure-I, Makes of sub vendor's items	2
6.0	Volume II B	Section-C	Annexure-III, Procedure for load /overload testing of TG hall EOT crane at Manufacture's works.	2
7.0	Volume II B	Section-C	Annexure-IV A, Painting Procedure	18
8.0	Volume II B	Section-C	Annexure-IV B, Color Coding Procedure	1
9.0	Volume II B	Section-C	Annexure-V, Drawing and documents including submission schedule and title block	3
10.0	Volume II B	Section-C	Manufacturing Quality Plan – EOT Crane & Customer specification for inspection & testing	36
11.0	Volume II B	Section-C	Data sheet –A/B: EOT Crane (with VVVF drives) including crane clearance diagram PE-DG-372-501-A001 Rev 00	16
12.0	Volume II B	Section-D	Technical Specification for VVVF Control drive	5
13.0	Volume II B	Section-D	Technical Specification for EOT Crane	23
14.0	Volume III	Section-D	Documents to be submitted along with offer including compliance cum confirmation certificate & .Specific confirmation / comments required from bidder .	5
15.0	Volume III	Section-D	Schedule of deviation(if applicable)	1
16.0	Volume III	Section-D	Schedule of Performance	1
17.0	Volume III	Section-D	Schedule of Dispatch	1
18.0	Volume III	Section-D	Schedule of Weights and Dimensions	1
			Technical specification (Electrical portion)	
19.0	Volume II B	Section-C	Equipment and services to be provided by bidder	1
20.0	Volume II B	Section-C	Electrical scope between BHEL and vendor	1
21.0	Volume II B	Section-C	Electrical Specification for LV motors	7

22.0	Volume II B	Section-C	Specific design data for motors (Data sheet A)	1
23.0	Volume III	Section-D	Data sheet-C– LV motors	3
24.0	Volume II B	Section-D	Quality Plan for AC motors below 55 KW (LV)	2
25.0	Volume II B	Section-D	Quality Plan for AC motors 55KW & above 55 KW	9
26.0	Volume II B	Section-D	General technical Requirements of Power and control cables	4
27.0	Volume II B	Section-D	Specific design data for Cables – Power & Control (Data sheet A)	2
28.0	Volume III	Section-D	Data sheet-C– Cables	4
29.0	Volume II B	Section-D	Misc. electrical items (Technical specification for Cable Trays and Accessories (including typical details of cable trays)	5
30.0	Volume II B	Section-D	Data sheet-A – Cable trays and Accessories	1
31.0	Volume III	Section-D	Data sheet-C – Cable trays and Accessories	3
32.0	Volume II B	Section-D	General technical Requirements for cabling installation (Cabling, wiring, junction boxes, earhitng lighting, etc..	4
33.0	Volume II B	Section-C	Specific design data - A (earthing & lighting protection system)	1
34.0	Volume III	Section-D	design data - C (earthing & lighting protection system)	1
35.0	Volume II B	Section-D	Quality Plan for cables	15
36.0	Volume II B	Section-D	Load data format (Electrical)	1
37.0	Volume II B	Section-C	Technical specification, Quality Plan & data sheet for Local control Panel	18

Note:

1.0 Bidder to note that BHEL reserves the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)

Scope of Enquiry



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
 400 MW MARIB GTPS
 POWER PROJECT, STAGE V

SPECIFICATION NO. PE-TS-388-501-A001

VOLUME II - B

SECTION -A

Rev 00

04.02.13

Page 1 of 2

A.0 SCOPE OF ENQUIRY

- 1.0 This specification includes, but is not limited to, the design, engineering, material selection, manufacturing and assembly, inspection, testing at manufacturer's works, packing, forwarding and transportation to site, unloading, storage & handling at Site, erection, commissioning and final load test at site of **One (1) no. double girder EOT Cranes(with telescopic hoist) with operator's cabin and necessary accessories** including supply of mandatory spares, operation and maintenance of cranes for 24 months.
- 2.0 Supplies and services shall be rendered in conformity with proven design principles, taking into account the current technology. The requirements of the contract must be fulfilled in its entirety.
- 3.0 It is not the intent to specify completely herein all the details of design and construction of equipments. However, all the equipment shall conform in all respect to high standard of engineering, design, workmanship and shall be capable of performing in continuous commercial operation up to the vendors / subcontractor's guarantees in a manner acceptable to the purchaser / engineer who will interpret the meaning of drawing and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 4.0 The supplies and services shall be rendered inclusive of all appliances and interconnecting arrangements with other supplies, necessary for installation of all accessories, needed for proper and reliable continuous operation and for satisfactory maintenance and repair.
- 5.0 In case of any data / requirement stipulated in the drawings but not in the specification and vice-versa, such data / requirement shall be deemed to be contained in both. Contradictions between drawings and specifications, if any, shall be brought to the attention of the Purchaser / Consultant by the Bidder and the correct requirement shall be obtained.
- 6.0 In the event of any conflict between the various sections of the specification, the more stringent of the two as per the interpretation of the purchaser shall be applicable..



**TECHNICAL SPECIFICATION FOR
DOUBLE GRIDER EOT CRANE**

400 MW MARIB GTPS
POWER PROJECT, STAGE V

SPECIFICATION NO. PE-TS-388-501-A001

VOLUME II - B

SECTION -A

Rev 00

04.02.13

Page 2 of 2

- 7.0 All necessary co-ordination with regard to sub-contracted equipment shall be carried out by the vendor. The Purchaser will communicate only with the vendor for all matters pertaining to this contract.
- 8.0 The general terms and conditions, instructions to bidder and other attachments referred to elsewhere are made a part of the tender specification. The equipment materials and works covered by this specification is subject to all the attachments referred in the specification. The bidder shall be responsible of and governed by all the requirements stipulated herein.
- 9.0 The standard quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed quality plan.

Project Information

400 MW MARIB GTPS PHASE-II, YEMEN

PROJECT INFORMATION-REV00

1.	Owner	PUBLIC ELECTRICITY CORPORATION, MINISTRY OF ELECTRICITY AND ENERGY , REPUBLIC OF YEMEN
2.	Project	400 MW MARIB GTPS PHASE-II
3.	Owner's consultant	The Kuljian corporation , Philadelphia , USA
4.	Location	Marib , Yemen
5.	Nearest Airport	El Rahaba Airport (SAH), Sana'a, Yemen
6.	Nearest Railway Station	No rail network in Yemen
7.	Access to site	<p>a. <u>Through sea</u>:</p> <ul style="list-style-type: none">Distance of site: From Aden Port (Gulf of Aden): 419 Km <p>b. <u>By Air</u> : Sana'a Airport</p> <ul style="list-style-type: none">Distance from site : 172 Km
8.	Site data	
A	Altitude	1100 m above Mean Sea Level
B	Ambient Air Temperature	45 °C

	1. Design Minimum Temp.	-----
C	RELATIVE HUMIDITY	
	Design Relative Humidity	60%
D	RAINFALL	
1.	Average Rainfall per annum	< 100 mm
E	WIND VELOCITY & PRESSURE	
1.	Max. Design Wind Velocity	120 km/h
2.	Max. Barometric Pressure Barometric Pressure at sea level	1023.6 mbar 887.7 mbar
F	SEISMIC ZONE	UBC 1997, Zone-2 A
9.0		
A	Design Ambient temperature for Gas Turbine & Mechanical equipment	45 °C
B	Design Ambient temperature of electrical equipment	50 °C
10.0	Electrical Details	Refer attached Anx-I

ANX-I

Electrical Power Sources and Equipment Voltage Rating

- i. 400,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
- ii. 33,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
- iii. 6600±10% volts, 3-phase, 50 Hz, low resistance grounded system.
- iv. 400±10% volts, 3-phase, 50 Hz, solidly grounded system
- v. 230±10% volts, 1-phase, 50 Hz, (PH/N of 400 volt) for lighting, receptacles and small power
- vi. AC 230 ± 5% volts, 50 Hz, 1-phase, for instrumentation and controls.
- vii. 220V / 125 / 24 / 48V (+) 10% to (-) 15% volts (DC), ungrounded system

Electric Equipment Voltage Rating

AC Equipment Voltage Rating

- | | | | |
|------|--------------------------------------|---|---------------------|
| i. | Motors larger than 250 kW | : | 6.6 KV, 3-ph, 50 Hz |
| ii. | Motors less than and equal to 250 kW | : | 400V, 3-ph, 50 Hz |
| iii. | Lighting with associated equipment | : | 230V, 1-ph, 50 Hz |
| iv. | MOV motors | : | 400V, 3-ph, 50 Hz |

Frequency : 50 Hz ± 5%

Fault Level

- | | | | |
|------|----------------------|---|---|
| i. | 400,000 volts system | : | 31.5KA for 3 sec. (In line with Phase - I) |
| ii. | 33,000 volts system | : | 31 kA for 3 sec. (In line with Phase - I) |
| iii. | 6600 volts system | : | 25 kA for 3 sec. (In line with Phase - I) |
| iv. | 400 volts system | : | Min. 50 kA for 1 sec. in line with Phase-I to be uprated based on calculation to be submitted for Phase - II. |
| v. | DC system | : | By Bidder for 1 sec. |



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00

04.02.13

Page

VOLUME - IIB

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

1.0.0. SCOPE OF WORK

1.1.0. SUPPLIES

1.1.1. Equipment and services to be furnished by the bidder for the EOT CRANES with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the **EOT cranes** units complete and efficient operation shall also be under the bidder's scope of work.

1.1.2 In the event of any conflict between the technical specification of equipment and the specified data sheet of the equipment, the more stringent of the two as per the interpretation of the purchaser shall govern.

1.1.3 Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified conditions.

Crane shall include but not be limited to the following: -

- a. Bridge girders
- b. End carriages with wheels
- c. Crab
- d. CT/ LT drive arrangement
- e. All electrical equipments
- f. PVC insulated shrouded Copper conductor cable
- g. Earthing arrangement.
- h. First fill of lubricant
- i. Painting of cranes
- j. Temporary cable for operation of each crane during erection stage of the plant (Half the bay length + 25m)
- k. Rail
- l. Maintenance tools & Tackle
- m. Erection & Commissioning spares
- n. Radio Remote Control
- o. Operator's cabin
- p. Electric hoist (telescopic hoist)



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

1.1.4 Maintenance Tools and Tackles

A complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied. Each tool and wrench shall be stamped so as to be identified, easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and specially protected against rusting in tropical climate and minimum the following shall be provided.

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Min. 6 Nos., Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5	Wrench spanner	1 No.
6.	Grease Gun	1 No.
7.	Oil Gun.	1 No.
8.	Hand Lamp.	1 No.
9	Line tester	1 No.
10.	Tool Box.	1 No.

Note: - Each Crane shall be supplied with one set of tool and tackles with O&M manual in the toolbox.

1.1.5 Erection and Commissioning spares

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable ones during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser reserves the right to retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

Note:

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

1.2.0 Services to be provided by the bidder

1.2.1. supply/delivery duly packed (sea worthy) at FOB CHA godown Mumbai Port / Mumbai port.

1.2.2. Arranging test load at site

Load testing at works as well as at site is in bidder's scope.

BHEL will arrange the load at the load test bed at site for conducting load testing by bidder. All the testing equipments, manpower (operator etc.) including cradle, sling as required is in bidder's scope. Test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the purchaser

1.2.3 Supervision of Erection and Commissioning at site

1.2.4 Performance Guarantee test

1.3.0. Inspection and Testing**1.3.1. Inspection and testing at Manufacturer's works**

Copy of documents approved with original stamp and signature (one set) shall be available at the place of Inspection. This is to be ensured by supplier.

A. Shop inspection and tests will include but not limited to the following -

- i) Identification, co-relation and verification of material test certificates for the important components like girders, major load carrying components, cross head, hooks, gears, shafts, wheels, wire rope drum, wire rope etc. In absence of Original copy of Mill Test Certificates/ photocopy certified by Mill in original, check test to be carried out and original test certificates to be furnished for each heat/ thickness. For other components supporting test certificates or random check tests shall be conducted / furnished. All test certificates shall be in original and legible. Photocopies certified by Mill/ manufacturer of raw material used, are acceptable.

For tensile testing of hooks/ forgings, samples shall be drawn from the full cross section of the shank diameter of hooks/ forgings Samples forged to reduced cross



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

section for testing purposes is not acceptable. **Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable.**

- ii Welding procedures and welders shall be qualified as per ASME Sec IX . Only qualified welders shall be employed on the job.
- iii 100% radiography of tension zone & 25% radiography of compression zone on butt welds of load bearing members shall be carried out with acceptance norms as per ASME Sec VIII Div.1 UW 51. DP test of all butt welds shall be carried out as per ASTM E 165/ ASTM E 109 with acceptance norms as per ASME Sec VIII Div.1 append.8. Radiographs shall be inspected to a sensitivity of 2%.
- iv For fillet welds visual inspection on all welds. Die- penetration test (DPT) for fillet welds in the load bearing members as per ASME-165/ASTME 109 and acceptance norm as per ASME section VIII Div. 1.
- v Ultrasonic test on forgings and casting of critical components like **cross head** (hook suspension block), Hooks, Shafts, Axles, Gears, Wheels, Pulleys etc. Ultrasonic test on forgings shall be carried out as per norms given below. UT shall be carried out in Proof machined condition (single diameter/ Flat surface without steps, keyways, teeth cutting or other profile machining which can create difficulty in ultrasonic testing). Components shall be identified with Heat number and serial number by punching). Hardening operation shall be carried out prior to Ultrasonic testing.

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps
2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.'
3. Group of defects with maximum indication less than that from a 4 mm dia equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.
4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per ASTM E 609. Wherever, the Quality plan calls for witness of Ultrasonic test by BHEL or BHEL's representative, the material shall be offered for UT in proof machined condition as stated above and hard stamping and subsequent stamp transferring by BHEL shall be followed at subsequent stages to ensure trace ability.

- vi. Dye penetration check/ Magnetic particle check on surfaces subjected to hardening process as per ASTM E 165 / ASTM E 138 respectively with acceptance norms as per ASME Sec. VIII Div.1 append.7 for DP check and ASME Sec. VIII Append. 6 for Magnetic particle check.
- vii. Gear boxes shall be checked at No load for backlash, tooth contact, noise and vibration as per Procedure No. PEM (Q)/001 enclosed (attached after Section C)
- viii. Test certificates shall be furnished for verification for Type tests including environmental tests - for electrical and electro-mechanical items. If Type tests for items with similar / identical construction are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customer's representative (as required). Type test Certificates shall be considered valid if the date of test is within previous five years of the date on which ordered items are offered for inspection/ verification
- ix. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification
- x. Functional and simulated operation test, sequencing, interlocks, safety, protection and alarm system shall be carried out for Control Panels. Test on CRANE / CRAB motors and other mechanical, electrical, electromechanical as per BHEL technical specification and / or as per applicable code.

B. Testing At Works.

Cranes shall be completely assembled at manufacturers works to check the misalignment of gears, shafts and other items. Gears shall be run idle for at least 4 (four) hours. Following minimum tests shall be conducted on the crane at the works of the manufacturer:

- a) No load running & speed check for LT drive.
- b) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

- c) Overload test (running of CT and Hoisting mechanism at 125% of the rated load).
Capability of crane to lift the overload from mid-air shall be demonstrated.
- c) Electrical tests for brakes, panel, electrical equipments etc as per IS - 3177
- d) No load run test of LT mechanism
- f) All Other tests as per IS-3177.
- g) All the tests for electric hoists(telescopic hoist) as per IS 3938.

Based on the Quality Plan and witness stages of BHEL & customer, supplier shall submit an inspection plan clearly indicating the no. of hours/ man days required for inspection.

Note: Refer annexue-III, section-C, volume II-B for “Shop test Procedure for Load/Overload testing of T.G. Hall EOT cranes at Manufacturer’s Works.

1.3.2 Testing at site

- a) All the tests as mentioned against S.N. 1.3.1 above.
- b) Speed test at rated load for hoisting / CT and LT mechanism.
- c) Brake test.
- d) Any other test as per IS-3177-1999
- e) The test shall be carried out with actual panel, RRC , Master controller etc.

1.4.0. SURFACE PREPARATION, PAINTING & COLOUR SCHEME

Bidder to refer ANNEXURE-IV A & B ,SECTION –C VOLUME II

1.5.0. Drawing / design document for submission.

A. For Approval

- a) G. A. Drawing showing clearances, assembly, cross section details, wheel details, chequered plate marks, material of construction, lifts and hook approach. The G.A. drawing shall indicate the permissible tolerance on dimensions indicated
- b) G.A. drawing showing layout crab, cross section details, material of construction, lifts and hook approach, Chequered plate marks, dimensions with tolerances, CT wheel details.
- c) Lifting wheel assembly drawing with calculation and fabrication details. (Project specific)
- d) DSL fixing arrangement and supports.
- e) Hook block assembly drawings



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

- f) Motors HP/KW calculations, brake selection calculation, cable sizing calculations, voltages drop calculation etc.
- g) Gantry Rail fixing Arrangement with accessories.
- h) Write up on the crane control
- i) Wire rope selection, gearbox selection, rope drum selection and wheel size selection calculation.
- j) Electrical wiring diagram and control scheme along with control write-up.
- k) Quality Plan
- l) Test certificates and reports on various shop tests
- m) Field quality plans
- n) O.M. Manuals
- o) Technical data sheet of all equipments / components

B For Reference

- a) Gearbox assembly drawing.
- b) Girder Assembly (without trolley) with LT Wheel details, chequered plate location, platform details, designed camber on girder and jacking pad location with details, rail fixing arrangement with details, critical dimensions with tolerances
- c) Rope drum assembly Drawing
- d) Cross conductor on bridge
- e) Crane lubrication arrangement
- f) LT & CT wheel Assembly drawing
- g) Manufacturers catalogue
- h) Motor characteristics curves
- i) Structural Calculation
- j) Detailed erection drawing (For export job)

2.0.0. Works Excluded

One/two nos.

2.1.0 The purchaser shall provide () . 400V, 3 phase, and 50Hz. 4 wire supply at operating floor near A-row column solidly grounded power feeder in the middle of the bay.

Any other supply required by the bidder shall be arranged by the bidder himself by using suitable transformer as per the specification.



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

3.0.0. Number of drawing and documents for submission

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

4.0.0. Deviations

If the proposal submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate “ Schedule of Deviations” furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause Number. Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall indicate so. Reasons / explanations for such deviations shall be furnished.

5.0.0. Performance Guarantee

EOT crane& hoist along with its drives, controls and other accessories shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified.

The bidder shall have the full responsibility for the safe and efficient operation of the crane with associated accessories as a single unit. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Performance tests shall be carried out each time after the rectification /modification is carried out.

PG test of the crane shall include load tests and speeds in various motions.

6.0.0. Makes of Sub - Vendor items

The makes of bought out items will be as per annexure-I, section C, volume II-B of the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser.

7.0.0. Drawing & Documents to be attached with Tender

7.1.0. SPECIFIC CONFIRMATION, AS PER ANNEXURE A, ATTACHED ALONG WITH THE TECHNICAL SPECIFICATION

7.2.0. DEVIATION, IF ANY, IN THE DEVIATION SCHEDULE ATTACHED ALONG WITH THE SPECIFICATION. IF THERE IS NO DEVIATION FROM THE TECHNICAL



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

**SPECIFICATION THE DEVIATION SCHEDULE SHALL BE SUBMITTED
INDICATING – NO DEVIATION**

**7.3.0. UNPRICED FORMAT IN BHEL FORMAT PROVIDED ALONG WITH THE TENDER
ENQUIRY**

8.0.0 Specific Requirement

8.1.0 Panels

Fabricated out of 2.0 mm thick rolled sheet. Degree of protection shall be IP-55. Paint shade as per ENCLOSED PAINTING SPECIFICATION. Space heaters shall also to be provided.

8.2.0 Suitable inspection cage to accommodate two persons to facilitate inspection of DSL

8.3.0 Cables

- a) ERP insulated copper conductor trailing cable as per IS-9968, on the bridge.
- b) Extruded PVC insulated copper/Aluminum conductor 1100V grade power and control cables. This shall include cable length between change over switch and DSL as mentioned elsewhere.

NOTE- FOR ALL THE ELECTRICAL ITEMS REFER ELECTRICAL PORTION
ENCLOSED WITH SPECIFICATION.

8.4.0 Parameter and tolerances for structural assembly is as per the relevant standards.

9.0.0 Scope of Documentations

The supplier shall submit required number of copies of each document as per
ANNEXURE-V DRAWING AND DOCUMENTS FOR SUBMISSION

These documents shall be completed in all respects. These will be including but not
limited to the following: -

- System Description
- System Performance
- Specification documents
- Design documents
- General layout drawings
- System block and level diagram
- Operation documents



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION - C

rev 00 | 04.02.13

Page

- Maintenance and service documents
- As Built drawings
- Software documents
- All documents shall be available in electronic for accompanied by the accessories of software or PC.

10.0.0 Specific technical requirement for electrical

10.1.0 Power supply

- a) The purchaser shall provide One (1) no. 400V, 3 phase, and 50Hz. 4 wire supply at operating floor near A-row column solidly grounded power feeder in the middle of the bay. Bidder shall provide a change over switch at 1.5 M above the operating floor level and cable required from isolating switch to DSL.
Any other supply required by the bidder shall be arranged by the bidder him self by using suitable transformer as per the specification.
- b) Two numbers isolating switches in enclosure at extreme ends of operating floor for disconnecting supply to DSL while maintaining the crane.
- c) DSL is to be sized considering maximum length from changeover switch and with a margin of 10% over load requirement. The DSL shall be designed to limit voltage drop at motor terminals within 3% for single length. The voltage drop in the power cable i.e. from changeover switch to DSL is also to be considered along with voltage drop in DSL and cable sizes shall be selected accordingly. Suitable guards of MS sheet to live electrical wiring down shop leads shall be provided.

Procedure No. PEM (Q) / 01 – Gear Box Qualifying Criteria

	Technical specification for EOT crane 400 MW MARIB GTPS	Spec. No. PEM(Q)/001
		Page 1 of 4 Section –C

1.0.0	Scope: Acceptance Norms for Crane Gear Boxes
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes.
2.0.0	The following dimensions shall be checked:
2.1.0	<ul style="list-style-type: none"> i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	Backlash
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	Area of Contact:
4.1.0	<p>Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2)</p> <p>For final stage of Hoist gearing:</p> <p>h / H shall be more than 30%</p> <p>$(a - c) / b$ shall be more than 40%</p> <p>For all other gears:</p> <p>h / H shall be more than 40%</p> <p>$(a - c) / b$ shall be more than 50%</p>
5.0.0	Running Test
5.1.0	<p>The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked:</p> <ul style="list-style-type: none"> i. All bolts at the joints remain tight ii. All gear mesh lines are getting enough lubrication

	Technical specification for EOT crane 400 MW MARIB GTPS	Spec. No. PEM(Q)/001
		Page 2 of 4 Section –C

	<ul style="list-style-type: none"> iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration : Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	General
6.1.0	<p>In addition to the above specific points, the following general points shall be ensured:</p> <ul style="list-style-type: none"> i. Inspection pockets are provided as required. ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line. iii. Dip sticks with minimum / maximum level markings are provided. iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing. v. Breathers are provided. vi. Lifting lugs or eye bolts are provided as required. vii. Wherever bearings have splash lubrication, oil retainers are provided. viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint. ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided. <p>Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.</p>

	Technical specification for EOT crane 400 MW MARIB GTPS	Spec. No. PEM(Q)/001 Page 3 of 4 Section -C
--	--	---

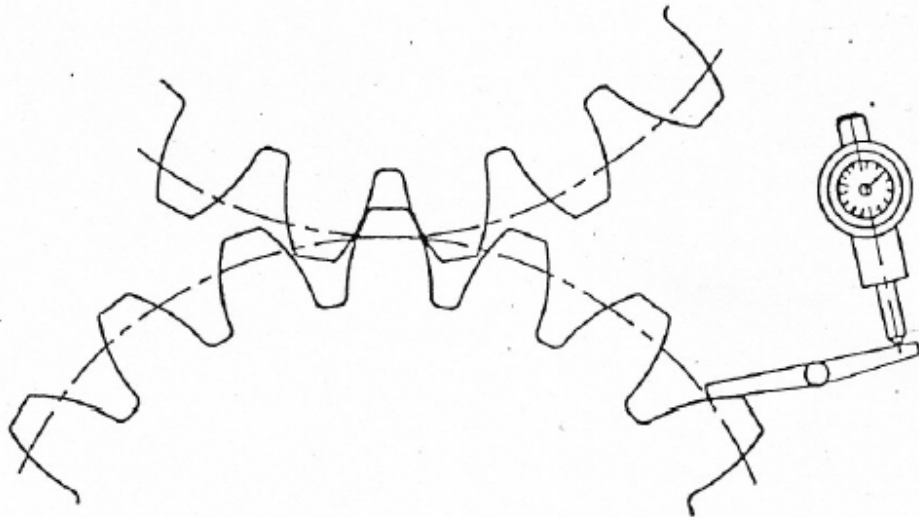


FIG.1 MEASUREMENT OF BACKLASH

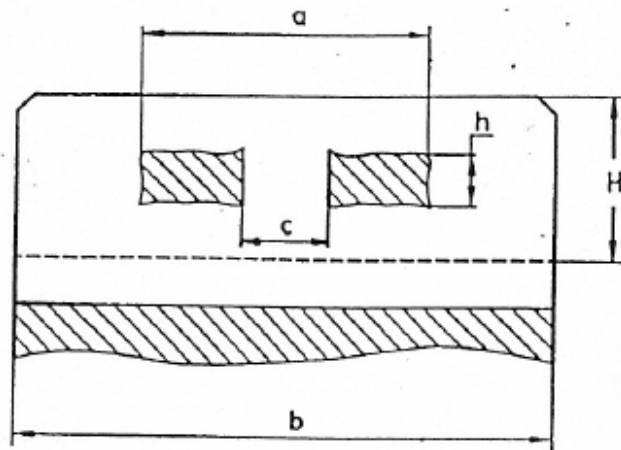


FIG.2 AREA OF CONTACT OF GEAR TEETH

	Technical specification for EOT crane 400 MW MARIB GTPS	Spec. No. PEM(Q)/001
		Page 4 of 4 Section –C

Table-1

**Backlash for Gearing specified by module
(Clause 3.1.0)**

Centre distance in mm		Tolerances in microns		
Above	Upto	Minimum	Maximum	
			For gears other than Drum gears	For Drum gears
			For all modules 1 to 50	For all modules 2.5 to 50
-	50	85	240	280
50	80	105	320	380
80	120	130	360	420
120	200	170	470	530
200	320	210	540	640
320	500	260	660	740
500	800	340	820	880
800	1250	420	970	1040
1250	2000	530	1200	1280
2000	3150	710	1500	1670
3150	5000	850	1810	1980

Annexure-I, Makes of sub vendor's items



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE**

400 MW MARIB GTPS
POWER PROJECT, STAGE II

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -C

REV 00

04.02.13

SHEET 1 OF 2

ANNEXURE-I

MAKES OF SUB VENDORS ITEMS

S.N.	ITEM	MAKES
1.0	STEEL	SAIL / IISCO / TISCO / JINDAL
2.0	HOOKS	KARACHIWALA / HARMAN MOHTA Steel Forging & Engg. Co., Kolkata/ SIMRITI FORGING
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM/SAHARA/NUTECH
4.0	WIRE ROPE	USHA MARTIN / BOMBAY WIRE ROPES / /FORT WILLIAMS / UNITED WIRE ROPE / Bharat Wire Ropes.
5.0	BEARINGS	SKF/ FAG/ TATA/ NORMA / NBC/ZKL
6.0	MOTORS	SIEMENS / NGEF/ CROMPTON / KIRLOSKAR / BHARAT BIJLI / ALSTOM / ABB (NGEF UPTO 15kW only)
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC / GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T./ GEC A / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ GEC A
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ GEC A /TELEMECHANIQUE
14.0	TRANSFORMERS	INDCOIL / LOGICSTAT/ KAPPA / AUTOMATIC ELECTRIC / SILKAAN ELECTRIC MFG. CO. LTD. / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS / UML ENGINEERS, KOLKATA/JAINSON
17.0	HOOTERS	BEACON / OSC/TARGET / KHERAJ
18.0	LIGHTING SWITCHES	ISI MARKED
19.0	CABLES	
a)	Power Cables	Nicco / Universal / Incab / Torrent / CCI / ICL / Radiant/POLYCAB



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANE**

400 MW MARIB GTPS
POWER PROJECT, STAGE II

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -C

REV 00 04.02.13

SHEET 2 OF 2

b)	Control cables	Nicco / Universal / Incab / Delton / Finolex / Torrent / CCI / ICL / Radiant
c)	Trailing Cables	Nicco / Universal
20.0	Cable gland	COMMET / SUNIL&CO. / ARUP ENGINEERING
21.0	PUSH BUTTONS	SIEMENS / L&T / BCH
22.0	Limit Switches	Speed-o-control / Electromag
23.0	Master Controller	Speed-o-control / Electromag
24.0	Safety switches	Alsthom / L&T / Siemens
25.0	Pendent Push button station	OEM
26.0	Indicating Lamps	Tecknic / BCH / Siemens / Standard/Telemechanique
27.0	MCB	MDS / Indo Copp / Standard/Siemens/L & T
28.0	Panels	OEM
29.0	Resistance boxes	OEM
30.0	Fire Extinguishers	BSI Approved Makes
31.0	Insulators & Copper Conductors	BHEL approved make
32.0	CASTING	KOLHAPUR STEEL / GNAT FOUNDARY / KIRTI ALLOYS
33.0	VVVF	YASKAWA (L&T) / ABB / SIEMENS/SCHNIEDER
34.0	Shrouded DSL	Susheel/ Stromag

Note: All the trailing cables shall be sourced from only one sub-vendor from the list

***Procedure for load /overload testing of TG hall EOT crane at
Manufacture's works.***



TECHNICAL SPECIFICATION
DOUBLE GIRDER EOT CRANE
400MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

REV 00

04.02.13

Page 1 of 2

ANNEXURE-III

Procedure for Load/Overload testing of T.G. Hall EOT cranes at Manufacturer's Works

Objective: To demonstrate final NO load / Load / Overload / Deflection / Functional tests of assembled Crane for the purpose of acceptance.

Basic Assumptions / Inputs for testing at Works:

- Actual job hook shall be used for load / overload tests for hoisting.
- Actual ropes shall be used for load / overload testing.
- Shop cables shall be used for temporary connection for the purpose of showing various functional tests at shop.
- Interlock and limit switch operation check will be shown with load for hoisting and CT motion.

Procedure for Load / Overload testing:

The cranes shall be tested for no load ,load test & overload test at works generally in conformance with the IS – 3177 (latest edition). Specifically with respect to the load / overload testing of crane, the following tests as per the outlined procedures shall be done at works.

- Deflection of the girder will be measured at SWL when the trolley with load is at the middle of the girder.
- No load and full load current of the motors will be measured to verify whether it is as per the approved data sheet of the motor. Resistors in the circuit will be checked for any overheating of the element.
- Overload relays will be checked for proper functioning.

Hoisting & Cross Travel motions:

The load will be gradually raised to 125 percent of the rated capacity (SWL) with actual hook. The load will be lifted upward to about 1 meter height above its support and stop again. Check for any undue drift in the load. If load drifts, check the adjustment of brakes and repeat the above procedure. Then lower the load to rest on support/ground.



TECHNICAL SPECIFICATION
DOUBLE GIRDER EOT CRANE
400MW MARIB GTPS

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

REV 00

04.02.13

Page 2 of 2

For checking the cross travel, raise the load up to one (1) meter height above supports and then move the trolley with load about one (1) meter in either direction of the bridge. Then lower the load to rest on support/ground.

Creep speed motions shall be checked over a distance of about 500 mm.

Note: Complete No load / load / over load tests in line with IS-3177 (latest edition) shall also be done after erection of EOT crane at site.

PAINTING SPECIFICATION

FICHTNER

Volume - IV

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				3

7.6.0 CLEANING, PROTECTIVE COATING AND PAINTING

7.6.1 General

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, components and system. The components and/or equipment shall be mechanically and /or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop
- Cleaning before painting and/or corrosion protection (application of prime coat)
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturer's works or at site, as appropriate.

For cleaning in workshop and before painting mechanical cleaning as opposed to alternative chemical cleaning is the preferred method for works cleaning except where this is precluded by design or access considerations.

Machined surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the purchaser's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted. Wire brushes used on austenitic steel bristles.

Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic/plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress relieved before chemical cleaning.

Codes and Standards

Internationally recognized codes and standards with purchasers approval shall be followed for the work covered by this contract.

Surface Preparation Standards

The following standards shall be followed for surface preparations:

- Swedish standard Institution - SIS-05 5900-1967 (Surface preparation standards for painting steel surfaces).
- Steel structures painting council, U.S.A. (Surface Preparation Specifications (SSPC-SP)).
- British Standards Institution (Surface Finish of Blast cleaned steel for painting) BS-4232.
- National Association of Corrosion Engineers, U.S.A. (NACE).
- Various international standards equivalent to Swedish standard for surface preparation are given in Table-1.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				4

The contractor shall arrange, at his own cost, to keep a set of latest edition of the above standards and codes at site.

The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

- a) Proper storage to avoid exposure as well as extremes of temperature.
- b) Surface preparation prior to painting.
- c) Mixing and thinning
- d) Application of paints and the recommended limit on time intervals between coats.
- e) Shelf life for storage.

Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the Engineer, who may, however, at his discretion authorise in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

Equipment

All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipment, scaffolding materials, shot/sand blasting equipment & air compressors etc. shall be arranged by the contractor at the site in sufficient quantity at his own cost. He shall arrange at his own cost, for suitable paint thickness measuring instrument like Elkometers acceptable to the Engineer (with calibration facilities).

Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer may allow the hand mixing of small quantities at his discretion.

7.6.2 Mechanical Cleaning at Manufacturer's Works

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Owner is prepared to consider alternative methods provided they achieve the necessary surface condition.

Surface condition:

The Metal surfaces shall be clean and free of mill scale, rust, dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform with the painting specification requirements.

Where this does not apply surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

Abrasives:

Abrasives containing silica, silicates or slag residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting with sand may be used.

For austenitic materials only, abrasives containing 98% or more of alumina, Al_2O_3 , shall be used.

Removal of abrasive and debris:

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6 SHEET NO. 5

After cleaning, abrasive and debris shall be thoroughly removed from components.

7.6.3 Alternative Chemical Cleaning at Manufacturer's Works

The procedure shall comprise:

Pre-treatment
Acid treatment

To achieve cleanliness equivalent to that specified for mechanical cleaning. The procedure to be adopted must meet with the purchaser's approval.

7.6.4 Protection at Manufacturer's Works

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapour phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square metre or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds. Cylindrical plugs shall not be driven into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

7.6.5 Weather Conditions

Painting shall be done only when the surface temperature is above 5°C. surface temperature must be at least 3°C above dewpoint to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation, corrosive fumes and vapours shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming or finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc., before drying, shall be permitted to dry and the damaged area of primer shall be removed and the surface prepared and primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this an additional top coat of paint shall be applied.

7.6.6 Surface Preparation

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired, so as to obtain a clean, dry, even surface to receive the priming or finishing coat (s) as called for in the

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				6

painting schedules. Sharp edges should be rounded, especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.

All surfaces should be blast cleaned whenever possible.

Surface preparation methods

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 59 00 or Steel Structures Painting Council, SSPC, Vis 1, or DIN 55928, section 4.

(a) White metal blast cleaning: Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal. Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic colour and correspond in appearance to the prints designated Sa 3.

(b) Near white metal blast cleaning Sa 2 1/2 or SSPC - SP 10

Sa 2 1/2. Very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

(c) Commercial Blast Cleaning Sa 2

Sa 2 Blast cleaning until atleast two-thirds of each element of surface area is free of all visible residues. This method of Blasing is suitable for steel required to be painted with conventional paints for exposure to mildly corrosive atmesphere for longer life of the paint systems.

(d) Near white metal blast cleaning P Sa 2 1/2 DIN 55928

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatment see Sub b).

The adhesivity of residual coatings in the transition zone has to be tested even after the application of the primer.

(e) very thorough mechanical scraping and wire burshing St 3

St 3 very thorough scraping and wire-burshing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for st 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

(f) Thorough scraping and wire brushing: St 2

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				7

with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

Table-1 (Surface Preparation Standards)

Surface preparation method	SIS 055900	DIN 55928, Part 4	BS 4232 only for blasting	SSPC-Vis
blasting acc.to item (a)	Sa 3	first quality	white metal	SP 5
blasting acc. to item (b)	Sa 2 1/2	second quality	near white	SP 10
blasting acc.to item (c)	Sa 2	Third quality	Commercial Blast	SP 6
derusting acc to item (f)	St 2	—	Hand tool/ power tool Cleaning	SP 2
acc. to items (e)	St 3	—	Power tool Cleaning	SP 3
Flame jet cleaning	F1	—	Flame cleaning	SP 4
Pickling	Be	—	Pickling	

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar g at the nozzle shall be used.

After blast-cleaning, all accumulated grit, sand, dust, etc., must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				8

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness P Sa 2 1/2 before touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. before the first coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.

7.6.7 Rub Down and Touch up of Primer

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer. The compatibility between shop coat and field primer should be ascertained from the paint manufacturer. In case degreasing with white spirit is not effective, the surface should be finally wiped clean with aromatic solvent like xylol or light naphtha.

7.6.8 Non Compatible Shop Coat Primer

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer.

Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.

Shop primed equipment and surfaces shall only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment.

For package units/equipment, shop primer shall be as per the paint system given for particular environment.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				9

In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case the coat is selected for upgrading existing alkyd coating to high performance coating, then surface preparation can be by manual/mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It should be touched with red oxide zinc chromate primer wherever it has peeled off before application of tie coat. The tie coat shall be applied after 7 days of curing of red oxide zinc chromate primer. If new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

7.6.9 Paint Materials

Plant and equipment shall be painted according to the colour scheme followed in Phase-I

7.6.10 Storage

All paints and painting material shall be stored only in rooms to be provided by the contractor and approved by Engineer for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separated from adjacent buildings. A signboard bearing the words "PAINT STORAGE - NO NAKED LIGHT - HIGHLY INFLAMMABLE - DANGER - NO SMOKING" shall be clearly displayed outside. All paints should be stored in the safest manner so that no container rolls down and causes accidents. The shelf life of the paints should be ensured so that the paint materials are not in storage and use after the date of expiry.

7.6.11 Preparation of Coating Materials

All container shall remain un-opened until required for use.

Primers and paints which have livered, gelled or otherwise deteriorated shall not be used.

The oldest primer or paint of each kind shall be used first.

All ingredients in any container shall be thoroughly mixed before use, and shall be agitated frequently during application to keep the primer in suspension.

Primer or paint mixed in the original container shall not be transferred until all settled pigment is incorporated into the body of the liquid.

Mixing in open containers shall be done in a well ventilated area.

Primer or paint shall be mixed in a manner ensuring the breakdown of all lumps, complete dispersion of pigment and uniform composition.

Two-component primers shall be mixed in accordance with the manufacturer's instructions.

Thinners shall not be added to primers or paints unless necessary for proper application according to the manufacturer's instructions.

When use of thinners is permitted, it must be added to the primer or paint during mixing.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				10

7.6.12 Application

Health and safety of work

The supplier has to check all painting work to be carried out according to the specification of the paint supplier further to all relevant prescriptions and regulations concerning the health and safety of work.

The paint supplier has to present a written specification including at least the flash point of the paints, ventilation requirements, handling precautions such as inhalation, eye and skin protection, and first aid procedure, storage requirements, spill or leak procedure, fire precaution, waste disposal.

7.6.13 Safety Requirements

Protection of the blast cleaner operator's eyes and respiratory system should be given prime consideration in any open blast cleaning operation. Airfed helmets, respiratory filters, air conditioned hoods etc. should be provided in sufficient number to the blast cleaning operators to avoid the harmful effect of blast cleaning abrasives. Also, an automatic shut-off device which will shut-off the air supply to the blasting machine should be installed which will prevent the dangerous whipping of an operating blast hose if an operator becomes disabled.

Methods

Temporary corrosion protections are to be completely removed prior to applying the definite one.

All prime coatings shall be applied by brush or airless spray or a combination of these methods, as approved by the coating manufacturer.

All doors, windows, stairways, handrails (if painted), bolts, flanges and equipment supports shall be finish painted by brush.

Spray guns should not be used outside in windy weather or near surfaces of a contrasting colour unless the latter is properly protected.

All cold-spray painting shall be done using standard equipment in accordance with accepted standards and methods.

Care has to be taken not to connect spraying devices for nitro and backelite paints simultaneously to oil based paints.

Paint applied to items that are not be painted shall be removed at the supplier's expense, leaving the surface clean, unstained and undamaged.

7.6.14 Dry Film Thickness (DFT)

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				11

To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats shall not be of the same colour.

Each coat of paint shall be allowed to harden before the next is applied. For epoxy paint the hardening time normally is 12-14 hours. Suppliers' recommendations regarding hardening time of epoxy paints must be followed.

Particular attention must be paid to full film thickness at edges.

The minimum total dry film thickness of the paint systems shall be as recommended in the following table. The dft is given in microns (millionths of a metre).

7.6.15 Protective Coatings and Paint Systems

The type and number of protective coats for any item requiring painting are to be in accordance in the attached tables "Paint Systems" (Annex-1).

Alternative to the 'paint system' specified, are to be presented on the schedule Departure from Specification, as indicated elsewhere.

Generally, all parts shall receive the specified prime coat (s) at the supplier's works to ensure that no corrosion occurs during transport to the site and storage at the site.

Parts which cannot be damaged during transport shall receive the full number of coats.

7.6.16 Colour Code for Piping

The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines should comply with the requirements (as per color coding in Spec).

Ground Colour shall be applied throughout the entire length for uninsulated pipes. For insulated pipes, on the metal cladding or on the pipes of material such as non-ferrous metals, austenitic stainless steel etc. Ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

- At battery limit points
- Intersection points & change of direction points in piping ways.
- Other points, such as midway of each piping way, near valves, junction joints of service appliances, walls, on either side of pipe culverts.
- For long stretch/yard piping at 50 M interval.
- At start and terminating points.

Identification Sign

Flow direction shall be indicated by an arrow in the location stated in Para a,b,c & d and as directed by Engineer.

Colours of arrows shall be black or white and in contrast to the colour on which they are superimposed. The size of the arrows shall confirm to relevant standards.

Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				12

Colour Bands

The width of colour band shall conform to the requirements as per spec.

Whenever it is required by the Engineer to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes shall be made as per the requirements of Phase-I

7.6.17 Identification of Vessels, Piping etc.

Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black or white shall be stenciled on all the pipe lines of more than one location as directed by Engineer, size of letters printed shall be as per applicable codes & standards

Identification of storage tanks: The storage tanks shall be marked as detailed in the respective drawing.

7.6.18 Inspection and Testing

All painting materials including primers and thinners brought to site by the contractor for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

Engineer at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batchwise test of wet paints for physical & chemical analysis. All costs thereof shall be borne by the contractor.

The paints shall be tested as per applicable codes & standards approved by the Owner.

The painting work shall be subject to inspection by Engineer at all times. In particular, following stagewise inspection shall be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- a. Surface preparation
- b. Primer application
- c. Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra coat to owner.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				13

7.6.19 Primer Application

After surface preparation, the primer should be worked by brush application to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer.

The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer before application of successive coats.

The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Elcometer for measuring the Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting, Holiday detectors and pinhole detectors for checking the painted surface discontinuities should be provided by the contractor.

At the request of Engineer, the contractor shall make arrangements for paint manufacturer to provide expert technical service at site as and when required. This service should be free of cost and without any obligation to the Purchaser, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

Final inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points/locations as decided by the Engineer and shall be within + 10% of the dry film thickness.

7.6.20 Guarantee

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

The contractor shall produce test reports from the manufacturer regarding the quality of the particular batch of paint supplied. The Engineer shall have the right to test wet samples of paint at random for quality of the same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

7.6.21 Scope of areas to be Painted and Painting Systems

The paint system adopted shall be suitable for Coastal and Marine environment as given in Annex - 1.

Primers and finish coats for any particular paint system shall be from same manufacturer in order to ensure compatibility.

7.6.22 Galvanizing

Galvanizing works shall conform in all respect to applicable standards and shall be performed by the hot dip process, unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with applicable standards.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				14

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably by blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with relevant applicable standards. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants. The weight of zinc coating per unit area has to be noted in the manufacturing documents.

Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 21/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 900 g/m².

On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor is achieved. care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Bolts, nuts and washers, including general grade high-tensile friction grip bolts shall be hot dip galvanized and subsequently centrifuged. Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is to be done as per the relevant standards.

Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with relevant standards.

- Cleaning the area of any weld slag rust and other impurities and by thorough wire brushing to give a metallic clean surface.
- application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with applicable codes, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface.

Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with relevant standards.

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				15

After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint. Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.

7.6.23 Sprayed Metal Coatings

Corrosion protection may be also achieved by spraying of suitable metals as zinc and/or aluminium on the surfaces of structures. For special cases tin, copper, lead can be used as well. Methods of surface preparation have to conform to relevant applicable standards. A proper treatment of the surface followed by an immediate spraying is to apply to ensure adhesion of the sprayed metal. The surface has to be clean, free of impurities, rust, millscale and rough enough to have binding properties to ensure good enticulation with the sprayed layer. Suitable roughness can be achieved by blast cleaning acc. to BS 4232. Welds are to be cleaned and prepared with special care. All surfaces to be treated have to be dry and accessible.

Application of coatings, requirements for thickness, adhesion, composition of coating metals, and subsequent treatment have to conform to relevant standards.

Testing of the spray coated layer are to be carried out in accordance with relevant standards.

The contractor has to specify the type, composition and thickness of the sprayed metal and of the sealing coating acc. to relevant applicable standards including the corresponding warranties and tests if sprayed metal coating will be applied.

7.6.24 Safety of Work

All precautions connected with this type of application of corrosion protection have to be in accordance with relevant standards.

Sprayed, unfused coating of metals and metallic compounds applied by combustion gas flame, plasma arc, detonation and similar processes, and the preparation of components, spraying techniques, sealing, finishing and inspection shall be according to relevant standards.

The hot galvanized surface has to be cleaned before the application of the coats to remove corrosion products, dirt, dust, grease.

The cleaning can be achieved by

- brush off
- washing with 1 - 1.5 % ammonia water with up to 0.1 % detergent added and followed by wet grinding using e.g. scotch britt to turn the foam to grey color,
- steam blasting,

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				16

ANNEX - 1

PAINT SYSTEM - COASTAL AND MARINE ENVIRONMENT

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM		GENERIC TYPE	PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS			IN SHOP	ON SITE
1	Structural steel work, piping (oil + water), tanks outside surface, transmiss, towers, cranes, steel floors, galleries, stairways, outdoor.	upto 130°C	Sa 2½	Prime	2	P6	35	x	
				Intermediate	1	P7	35 100	x	x
				Finish	1	F2	50		x
						Total min. dft	220		
2	Structural steel work, piping, indoor and outdoor	130 to 200°C	Sa 2½	Prime	1	F9	75	x	
				Intermediate	1	F9	20		x
				Finish	2	F11	20 20		x x
						Total min. dft	135		
3	Structural steelwork, piping, uninsulated carbon steel, indoor and outdoor	200 to 400°C	Sa 3	Prime	1	F9	75	x	

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				17

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM		GENERIC TYPE	PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS			IN SHOP	ON SITE
4	Structural steel work, piping (oil + water), tanks, indoor	upto 130°C	Sa 2½	Intermediate	1	F12	20		x
				Finish	1	F12	20 115		x
				Prime	2	P6	35	x	
							35	x	
				Finish	1	F6	100		x
						Total min. dft	170		
5 (a)	Structural steel work in the battery rooms,	Ambient	Sa 3	Prime	2	P8	30 30	x x	
				Finish	2	F6	100 100		x x
						Total min. dft	260		
				Prime	2	P3	35 35	x x	
				Finish	2	F6	100 100		x x
						Total min. dft	270		
(b)	Uninsulated - equipment, tanks and piping etc.	upto 80°C	Sa 3	Prime	2	P3	35 35	x x	
				Finish	2	F6	100 100		x x
						Total min. dft	270		

FICHTNER

Volume - IV

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				18

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM		GENERIC TYPE	PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS			IN SHOP	ON SITE
6	Steel tanks inside surface (total) for oil storage	normal	Sa 2½	Prime	2	P3	35 35	x x	
				Finish	2	F6	100 100		x x
						Total min. dft	270		
7	Steel tanks inside surface (total) for water storage (potable and distilled water)	normal	Sa 2½	Prime	2	P2	50 50	x x	
				Finish	2	F3	30 30		x x
						Total min. dft	160		
8	Cast iron water pipe lines-outside surface, buried in the soil	upto 60°C	Sa 3	Prime	2	P8	30 30	x x	
				Finish	3	F7	125 125 125		x x x
						Total min. dft	435		
9	Steel pipes inside surface such as cooling water lines	upto 60°C	Sa 2½	Finish	4	F7	125 125 125 125		x x x x
						Total min. dft	500		

FICHTNER

Volume - IV

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6
				SHEET NO.
				19

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			GENERIC TYPE	PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS				IN SHOP	ON SITE
10	Water pipelines - outside surface, indoor	upto 60°C	Sa 3	Prime	2		P2	50	x	
								50	x	
				Finish	3		F3	30		x
								30		x
								30		x
						Total min. dft	190			
11	Oil pipelines - outside surface, above ground	upto 90°C	Sa 3	Prime	2		P3	50	x	
								50	x	
				Finish	2		F6	100		x
								100		x
* For Details of Primer and Finish coats, refer Annex to paint systems.										

* For Details of Primer and Finish coats, refer Annex to paint systems.

Detail of primer & Finish Coats (annexure to painting system)

Primers:-

P-2 (High build chlorinated rubber zinc phosphate primer)

P-3 (High build zinc phosphate primer)

P-6 (Epoxy zinc phosphate primer)

P-7 (Epoxy high build MIO paint)

P-8 (Epoxy red oxide zinc phosphate primer)

FINISH COATS:

F-2 (Acrylic polyurethane paint)

F-3 (Chlorinated rubber paint)

F-6 (Epoxy high build coating)

F-7 (High build coal tar epoxy)

F-9 (Inorganic zinc silicate coating)

F-11 (Heat resistant aluminium paint suitable upto 250 Deg.C)

F-12 (Heat resistant silicone paint suitable upto 400 Deg.C)

COLOUR CODING PROCEDURE


	TITLE DOUBLE GIRDER EOT CRANE AND EOT CRANE (MARIB GTPS)	SPECIFICATION NO. PE-TS-372-501-A-001	
		VOLUME II B	
		SECTION-C	
		REV. 00	DATE: 04.02.13
		SHEET 1 OF 1	


COLOR CODING PROCEDURE / SCHEME


S.No	ITEM DESCRIPTION	REGION	SURFACE PREP.	PAINTING SCHEME							COLOUR SHADE	REMARKS
				PRIMER	MIN DFT μ	INTERMEDIATE	MIN DFT μ	FINISH	MIN DFT μ	TOTAL DFT		
				As per paint specification								
a	Crane structure	—	—	—	—	—	—	—	—	—	Lemon yellow, shade 356 as per IS-5	
B	Bottom block assembly	—	—	—	—	—	—	—	—	—	Lemon yellow, shade 356 as per IS-5	With black strip
C	Hooks	—	—	—	—	—	—	—	—	—	Lemon yellow, shade 356 as per IS-5	With 100 mm wide black zebra strip
d.	End carriage sweep	—	—	—	—	—	—	—	—	—	Lemon yellow, shade 356 as per IS-5	With black strip
e.	Panels and motors	—	—	—	—	—	—	—	—	—	Steel grey / as req. by purchaser	


***Manufacturing Quality Plan – EOT Crane & Customer specification for
inspection & testing***

MQP for CRANE


		MANUFACTURES NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS			
				ITEM:EOT CRANE	QP NO :	PE-VO-STD- 501-A101	PACKAGE : DOUBLE GIRDER GT HALL CRANE				
					REV :	0	CONTRACT NO : PE-TS-372-501-A001				
				SUB -SYSTEM	DATE :		CONTRACTOR : BHEL				
					PAGES :	7	VENDOR'S QAP No				
					REFERENCE		Rev No. 3 R1				
SL. NO.	COMPONENETS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS	
1	4	3	4	5	6	7	8	9	D* ** 10	11	
1	Fabricated components										
	Box Girder, End Carriage, Crab Frame, Rope Drum										
a	Material	Chemical/Physical	Major	Corelation with T.C.	1/Heat/Batch	IS:2062-Gr A/B	IS:2062-Gr A/B	Mfr's T.C/	✓	P V V	
		Tensile yield, elongation & Composition		Check test in absence of T.C.				Vendor's T.C.		Up to 10 mm thick compliance certificate to be furnished Refer note: 1	
		U.T of plates.		Ultrasonic	100%	ASTM A435	ASTM A435	T.C.	✓	P V V	
b	weld setup	dimensions	Major	Measurement	100% for butt joints	Components drawings	IS:9595	Vendor's inspection report		U.T. ON ABOVE 25MM THICK PLATE	
2	Welding WPS (Welding procedure specification) in line with ASME sec. IX (QW - 482) - For Box Girder, End Carriage, Crab Frame, Rope Drum										
i	Check for welding procedure qulification, welder's performance	Welding parameters	Major	check & test	100%	ASME Sec-IX	ASME Sec-IX	QW-482,QW-483 QW-484 ASPER asme Sec-IX	✓	P V V	
										Welder / procedure qualifiaction will be witnessed by customer / BHEL as per approved WPS. In case the BHEL / NTPC / Looyds / any other renowned approving agency already available & doing the job , requalification not required.	
ii	Back chipping	surface defect	Major	DPT	100%	ASME Sec-VIII, Div-I, Appen - 8	ASME Sec-VIII, CL UW51	Vendor insp. Report	✓	P V V	
iii	Butt Welds	Weld Quality	Critical	Gamma ray Radiography	100% in tension 25% in compression zones & 100% for butt weld of rope drum	ASME Sec - VIII	ASME Sec-VII, CL UW51	Vendor insp Repot Rad report & film	✓	P V V	
										Review of inspection report & radiography report and RT flims . Refer note: 2	
			Critical	DPT	100%	IS: 3658	ASME Sec-VII, Appen - 8	Vendor insp Repot Rad. report & film	✓	P W V	
										RT before stress relieving. DP test of filletweld for ropedrum to be conducted after final machining Random witness by BHEL.	
		LEGEND :									
		D * RECORDS INDETIFIED WITH "TICK"() SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION									
		** M : MANUFACTURER/SUBCONTRACTOR									
MANUFACTURER/ SUBCONTRACTOR	CONTRACTOR	C: BHEL-CQS									
		INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW									
SIGNATURE		N : TPCL									
							REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL			


		MANUFACTURES NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS			
				ITEM: EOT CRANE				PACKAGE : DOUBLE GIRDER GT HALL CRANE			
				SUB -SYSTEM				CONTRACT NO : PE-TS-372-501-A001			
				PAGES : 7				VENDOR'S QAP No			
SL. NO.		COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF RECORDS	AGENCY	REMARKS
1		4	3	4	5	6	7	8	9	D* ** 10	11
iv		fillet welds	Size and surface defects	Major	Visual	100%	Component Drg.	Component Drg.	Vendor insp.		
					DPT	10% RANDOM	ASME Sec VIII-Div1-Append 8	ASME Sec VIII-Div1-Append 8	Vendor insp.	✓	P V V
v		final inspection of fabricated components listed in Sr.2	Dimensions for Girder, and carriage rope drum etc. Camber, Verticality, bend etc	Major	Dimensional	100%	G.A. Drg. Cendor tolerance chart	G.A. Drg. Cendor tolerance chart	Vendor route		P V V
vi		Heat treatment of rope drum	stress relieving	Major	Review of SR chart	100%	ASME Sec-VIII, Div - I	ASME Sec-VIII, Div - I	SR Chart	✓	P V V
3		Gear box casing									
a		Material	Surface condition	Major	Visual	100%	Component Drg.	Component Drg.	Vendor insp	P	Refer note 1
			Chemical & mech		Measurement	100%	Component Drg.	Component Drg.	T.C. & I.R.		
					Correlation with T.C. Check test in absence of T.C. Correlation	100%	IS:2062	IS:2062		✓	P V V
b		welding	Welding & Dimensional conformity	Major	Measurement	100%	Component Drg.	Component Drg.	Vendor insp	P	
c		Heat treatment	stress relieving	Major	Review of SR chart	100%	Component Drg./	Component Drg./	Vendor insp	✓	P V V
4		PLATFORMS	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp	P	Refer note: 1
5		L.T.FRAMES	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp	P	
6		HAND RAILINGS	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp	P	
7		CABIN	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp	P V	
			LEGEND :								
			D * RECORDS IDENTIFIED WITH "TICK" () SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION								
			** M : MANUFACTURER/SUBCONTRACTOR								
MANUFACTURER/ SUBCONTRACTOR		CONTRACTOR	C: BHEL-CQS								
			INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW								
SIGNATURE			N : TPCL					REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL		

		MANUFACTURES NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS			
				ITEM: EOT CRANE				PACKAGE : DOUBLE GIRDER GT HALL CRANE			
				SUB -SYSTEM				CONTRACT NO : PE-TS-372-501-A001			
				PAGES : 7				VENDOR'S QAP No			
SL. NO.		COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF RECORDS	AGENCY	REMARKS
1		4	3	4	5	6	7	8	9	D* ** 10	11
8		Current collector arms	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp	P	
9		DSL Guard	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp	P	
10		Rails	Dimensional conformity,	Minor	Measurement, Check test, chemical, Hardness	100%	G.A.drg./DIN-536.	G.A.drg./DIN-536.	Vendor	√	P V V
						One/Cast	Appd.Data Sheet	Appd.Data Sheet	Report		
11		MECHANICAL COMPONENTS									
A		a wheels									
		i) Materials	Chemicals composition and Mechanical Properties.	Major	Correlation with mfr's TC	100%	Drg.regmt/IS:1570 c55Mn75 / (55c8)	Drg.regmt/IS:1570 c55Mn75 / (55c8)	Test	√	P V V Refer Note:1
		ii) Machined	a) Dimensions	Major	Measurement	100%	Component Drawing	Component Drawing	Vendor insp.	P V V	
			b) Hardness		Mechanical	100%	Approved Data Sheet	Approved Data Sheet	Report	√	P V V
			c) UT		NDT	100%	ASME Sec-VIII-App-8	ASME Sec-VIII-App-8		√	P V V Refer note: 5
			d) DPT		NDT	100%	Refer Note 6	Refer Note 6		√	P W V
		b Gears , Pinions, Shafts, Axes etc	i) Chemicals Composition & heat treatment, Mech Properties.	Major	Correlation with mfr's TC	100%	Component Drawing, IS:1570 C55, Mn 75 (55C8)	Component Drawing, IS:1570 C55, Mn 75 (55C8)	Vendor insp.	√	P V V
					Check test in absence of TC		Approved Data Sheet	Approved Data Sheet	Report		
					Correlation with						
			ii) UT (after proof machining)	Major	check for UT (above 50mm dia)	100%	ASME Sec-V	Refer Note 6	Vendor insp.	√	P V V UT & Hardness witnessing before teeth cutting & co-relation to be mentioned in final stages by supplier. (on Gears, Pinions only). Refer Note: 6
			iii) Hardness	Major	check for UT	100%	Approved drg. &	Approved drg. &	Vendor insp.	√	P V V
					Hardness		Approved Data Sheet	Approved Data Sheet	Report		
			iv) Dimensions	Major	Measurement	100%	Component Drawing	Component Drawing	Vendor insp.	√	P V V
									Report		
			V) D.P.Test on teeth	Major	NDT	100%	ASTME-165	No Crack and line of indication	Vendor insp.	√	P V V
									Report		
			LEGEND :								
			D * RECORDS INDETFIED WITH 'TICK'() SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION								
			** M : MANUFACTURER/SUBCONTRACTOR								
MANUFACTURER/ SUBCONTRACTOR		CONTRACTOR	C: BHEL-CQS								
			INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW								
SIGNATURE			N : TPCL					REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL		


		MANUFACTURES NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS			
				ITEM: EOT CRANE		QP NO :	PE-VO-STD- 501-A101	PACKAGE : DOUBLE GIRDER GT HALL CRANE			
				SUB -SYSTEM		REV :	0	CONTRACT NO : PE-TS-372-501-A001			
						DATE :		CONTRACTOR : BHEL			
						PAGES :	7	VENDOR'S QAP No			
						REFERENCE		Rev No.		3	R1
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF RECORDS	AGENCY	REMARKS	
1	4	3	4	5	6	7	8	9	D*	**	10
B	Pulleys, Brake, drums, break, Gear, coupling & other major steel castings & forging										
	i) Materials	Physical/Chemical/Hardness except pulleys.	Major	Corelation with mfr's TC	100%	Components Drawing	Components Drawing	Mfr's T.C.	✓	P	V
	ii) Machined	a) Dimensions	Major	Measurement	100%	Components Drawing	Components Drawing	Vendor insp report		P	V
		b) DPT in groove after machining for pulleys only.	Major	NDT	100%	ASTM E-165	No. crack /Liner indication	Vendor insp. Report	✓	P	V
C	Gear box assy & idle running	check for oil leakage, Noise level, backlash, rise in temp. after 2 Hrs. of running, tooth contact, vibration	Major	Visual & Measurement	100%	Vendor standard	Smooth running no oil leakage Noise	Vendor insp. Report	✓	P	W
							80 db at 1 Mtr. Vibrat. 75 Micron. Max. Temp. rise 40oC above amb.				Vendor's standard to be approved by BHEL.
D	a) Top block, bottom block	dimensional conformity	Major	Masurement	100%	Assembly drawing	Assembly drawing	Vendor insp. Report		P	V
	b) Hook	Heat treatment, chemical composition, physical properties on integral test bar	Major	Corelation with TC and testing	100%	Profile: IS:IS5749(80T), IS3815(25T) Material: Class II-IS:1875 (for 80T & 25T)		Test Certifacte & Insp. Report	✓	P	V
		UT on raw material of hook	Major	UT	100%	ASME sec-v	Annex-1		✓	P	V
		Forging operation of hook	Major	Visual	100%	IS:3815/IS:5749	IS:3815/IS:5749		✓	P	W
		Proof load test	Major	Mechanical	100%	IS:3815/IS:5749	IS:3815/IS:5749		✓	P	W
		UT & MPI after proof load test (UT on shank portion only)	Major	UT & MPI	100%	ASME sec - v	Annex-1 for UT No crack & liner indication (For MPI)		✓	P	W
E	Rope drum assembly	Diemnsional conformity	Major	Measurement	100%	Component Drawing	Tolerance as per drg	Vendor insp Report		P	V
		LEGEND :									
		D * RECORDS INDETIFIED WITH 'TICK' () SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION									
MANUFACTURER/ SUBCONTRACTOR	CONTRACTOR	** M : MANUFACTURER/SUBCONTRACTOR C: BHEL-CQS									
		INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW									
SIGNATURE		N : TPCL					REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL			


		MANUFACTURES NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS			
				ITEM: EOT CRANE				PACKAGE : DOUBLE GIRDER GT HALL CRANE			
				SUB -SYSTEM				CONTRACT NO : PE-TS-372-501-A001			
				PAGES : 7				VENDOR'S QAP No			
SL. NO.		COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF RECORDS	AGENCY	REMARKS
1		4	3	4	5	6	7	8	9	D* ** 10	11
F		Other Misc. components									
		i) Material	Chemical composition	Major	Review mfr's TC	100%	Mfr's catalogue	Mfr's catalogue	Mfr's a T.C.	✓	P V V
		ii) Machined	Dimensional conformity	Major	Measurement	100%	Component Drawings	Vendor insp.	Vendor insp.	P	
								Report	Report		
12		Electrical components									
i)		Motors (≤ 50 KW)	Routine test	Major	Review mfr's TC	100%	IS:325	IS 325/Mfr's T.C.	Mfr's T.C.	✓	P V V Refer Note 3.
ii)		Brakes	Routine text	Major	Review mfr's TC	100%	Mfr. Std	Mfr. Std	Mfr's T.C.	✓	P V V
iii)		Control panel	interlocking fuctional, IR	CR	Test for HV	100%	Relevant drg & IS 8623	Relevant drg/ IS 8623	Vendrs insp	✓	P W W Refer Note No. 4
			HV, Sheet thkness		functional &		Generally confirm to		Report		VFD Test Certificate to be
			Overall diemsnions , painting		routine check		IPSS-1-10-002-82				submitted from L&T/Yaskawa
			shade, Panel surface finish,								/Vendor for verification.
			Thickness, adhesive test,								
			Component fixing, Degree of								
			protection by paper inserting								
			method								
iv)		Resistance boxes	HV,IR,Temp,rise, measure	Major	Verification	100%	Generally confirm to	Generally confirm to	Mfr's T.C.	✓	P V V
			ment f resistance values				IPSS-1-10-002-82	IPSS-1-10-002-82			
iv)		Master controllers	HV, IR,Sequence Test	Major	Verification	100%	Approved drawings	Approved drawings	Mfr's T.C.	✓	P V V Refer Note No. 4
iv)		Limit swtches	HV, IR & Functional	Major	Verification	100%	Approved drawings	Approved drawings	Mfr's T.C.	✓	P V V
iv)		Trailing cable, Power	Routing & acceptance test	Major	Verification	100%	IS: 4289,IS: 9968	IS: 4289,IS: 9968	Mfr's T.C.	✓	P V V
		and Control Cable.	ment f resistance values			10% min	(IS7098,IS 1554)-Part-1				
			LEGEND :								
			D * RECORDS INDETIFIED WITH "TICK"() SHALL BE ESSENTIALLY								
			INCLUDED BY CONTRACTOR IN QA DOCUMENTATION								
			** M : MANUFACTURER/SUBCONTRACTOR								
MANUFACTURER/	CONTRACTOR		C: BHEL-CQS								
SUBCONTRACTOR			INDICATE "P" PERFORM "W" WTINESS AND "V" DOCUMENT REVIEW								
SIGNATURE			N : TPCL				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL			


	MANUFACTURES NAME & ADDRESS			MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS			
								PACKAGE : DOUBLE GIRDER GT HALL CRANE			
				ITEM:EOT CRANE				CONTRACT NO : PE-TS-372-501-A001			
				SUB -SYSTEM				VENDOR'S QAP No			
SL.	COMPONENETS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY	REMARKS	
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M C N		
1	4	3	4	5	6	7	8	9	D* **	10	11
13	Brought our items										
	Wire rope	Identification,Grade & dimensional	Major	Visul corelation	100%	IS:2266	IS:2266	T.C.	✓	P	V V
i)		conformity breaking strngth		with TC							
ii)	Other Items	Dimensional conformity	Major	Review TC	100%	Relevant Drg.	Relevant Drg.	Vendor		P	V V
								Confirmation			
iii)	Bearing	Type Size	Major	Verification		Appd drg/Mfr'scatalogue	Appd drg/Mfr'scatalogue		✓	P	V V
14	Assembly of cranes										
i)	Bridge with LT	Dimesions, wheel level	Major	Measurement	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor insp.	✓	P	W V
		alignment						report			
ii)	Crab assembly	Dimesions, wheel level	Major	Measurement/	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor insp.	✓	P	W V
		alignment		Visual				report			
iii)	Final Inspection	Overall dimension: Span, Diagonal dimension	Major	Measurement	100%	Approved drgs./IS :3177	Approved drgs./IS: 3177	Vendor insp.	✓	P	W W
		check, Eqp. Layout on bridge platform, No						report			
		Load running of LT machinery for direction									
		and speed with VFD									
		Load Tests									
		a) No load: Hoists,CT,LT speed & current	Major	Measurement	100%	Approved drgs	Approved drgs	Vendor insp.	✓	P	W V
		measurement..						report			
		b) SWL: Hoists, CT speed current	Major	With temporary	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor crane test		P	W V
		& Deflection measurement		wiring/Shop		Tech. Specification	Tech. Specification	report			
				testing panel							
		c) Overload: Hoists, CT movement.	Major	Operational		GA drg/IS:3177	GA drg/IS:3177	Vendor crane test	✓	P	W V
				Check		Tech. Specification	Tech. Specification	report			
15	Review of QA documentation						As per approved QAP			V	V V
16	Cleaning and Painting	Sand, blasting,painting	Major	Visual		As per Client's specs	As per Client's specs	Vendor's		P	V
								Report			
Note 1 : 1. Original TCs / Photocopies certified in original by mill shall be furnished for review. Test .In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.											
Note 2 : 4. X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.											
Note 3 : For Motors of 50 KW rating and above Routine Test will be witnessed by BHEL and Type Test Certificate will be reviewed for validity and conformance. For below 50 KW rating routine tests to be witnessed by											
	supplier of crane and Type test reviewed for validity and conformance. Photocopies of Type Test certificates are acceptable but shall be duly authenticated by Manufacturer										
Note 5. Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:											
	(i) Cracks, flakes, seams and laps										
	(ii) Defects giving indications larger than 6 mm diameter equivalent flaw.										
	(iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%.										
	(iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four time the length of the larger of the adjacent flaws										


		MANUFACTURES NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT: MARIB GTPS				
								PACKAGE : DOUBLE GIRDER GT HALL CRANE				
				ITEM:EOT CRANE		QP NO :	PE-VO-STD- 501-A101		CONTRACT NO : PE-TS-372-501-A001			
				SUB -SYSTEM		REV :	0		CONTRACTOR : BHEL			
						DATE :			VENDOR' S QAP No			
						PAGES :	7		Rev No.			
SL.	COMPONENETS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY	REMARKS		
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N	
1	4	3	4	5	6	7	8	9	D*	**	10	11
Note 6. Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable (i) Cracks, flakes, seams and laps (ii) Defects giving indications larger than 4 mm diameter equivalent flaw. (iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%. (iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four time the size of the larger of the adjacent flaws For hooks, for carrying out UT on the areas where there is loss of back wall echo due to geometry, the calibration shall be done on blocks of same material of similar thickness having Flat Bottom holes of required size as given above.												
Note Perofrmnaace of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works.												
Note A1 material of construction shall be as per apprived drg. / data sheet // specifications												
LEGEND :												
D * RECORDS INDETIFIED WITH "TICK"() SHALL BE ESSENTIALLY												
INCLUDED BY CONTRACTOR IN QA DOCUMENTATION												
** M : MANAFACTURER/SUBCONTRACTOR												
C: BHEL-CQS												
MANAFACTURER/ SUBCONTRACTOR	CONTRACTOR	INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW										
SIGNATURE		N : TPCL						REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL		

MQP FOR ELECTRIC HOIST

<div><div>बी एच ई लि</div><div></div></div>		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT		MARIB GTPS				
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		WIRE ROPE ELECTRIC HOIST				
						REV	0	CONTRACT No						
						DATE	Aug-11	CONTRACTOR		BHEL				
						PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY				REMARKS
									D*	M	C	N		
1	2	3	4	5	6	7	8	9		**	10		11	
1.0	RAW-MATERIALS													
1.1	STRUCTURAL MATERIAL , RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE , ROPE DRUM (IN CASE OF FABRICATED) ETC	MECH. , CHEM. PROPS	MA	CHEMICAL & MECHNICAL	1 / lot	IS 2062 Gr A/B,APPD. DRG./ DATA SHEET	IS 2062 Gr A/B, APPD. DRG./ DATA SHEET	Mill.s TC	√	V	V	V	Test shall be carried out in absence of mill TC	
		NDT FOR PLATE THICKNESS > 25MM.	MA	UT	100%	ASTM A 388-2004	NOTE 3	IR	√	V	V	V		
1.2	GEARS, SHAFT/AXLES, WHEELS , PINIONS	MECH , CHEM. PROPS	MA	CHEMICAL COMPOSITION, HARDNESS (DURING IN-PROCESS)	I / LOT	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	In case the items are not manufactured in-house, the manufacturer's test certificate shall be submitted for chemical	
		U.T FOR DIA/THK > 50mm	CR	NDT	100%	ASTM A 388	NOTE 3	INSPN. REPORT	√	P	V	V		
1.3	WIRE ROPE	TYPE, DIMESIONAL CHECK	MA	DIAMETER	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V		
		BREAKING LOAD CONSTRUCTION	CR	BREAKING LOAD	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS: 2266	APPROVED DRG/DATA SHEET AND / IS:3938 / IS:2266	MFRS' TEST CERT.	√	P	V	V		
1.4	HOOKS	PHYS./ MECH. , CHEM. PROPS.	MA	CHEMICAL COMPOSITION, HARDNESS	I / LOT	IS:3938 / IS:15560	IS:3938 / IS:15560	MFRS' TEST CERT.	√	P	V	V		
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY	
		PROOF LOAD CAPACITY	CR	PROOF LOAD TEST	100%	IS:3938 / IS:15560	IS:3938 / IS:15560	INSPN. REPORT	√	P	V/W	V	NO WITNESS UPTO 10T. FOR ABOVE 10T BHEL /THIRD PARTY WITNESS FOR PROOF LOAD, UT & DP AFTER PROOF LOAD.	
		DP AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V		
1.5	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL,PHYSICAL, FLATTENING AND ACID ETCHING TEST	MAJOR	LAB ANALYSIS VISUAL	I / LOT 100%	ASTM A 106/53 GR A/B,	ASTM A 106/53 GR A/B, FREE FROM CRACKS , PITTING , RUST	INSPN. REPORT, MTC	√	P	V	V		
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V		
2.0	IN-PROCESS													
2.1*	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	SCRUTINY	100%	IS:7307 / ASME SEC IX	IS:7307 / ASME SEC IX	FORMAT OF IS / ASME SEC IX/ QW 482		P	V	V	NOT REQD. FOR HOIST OF CAPACITY 10 TON & BELOW	

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT MARIB GTPS						
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		WIRE ROPE ELECTRIC HOIST				
						REV	0	CONTRACT No						
						DATE	Aug-11	CONTRACTOR		BHEL				
						PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	D*	M	C	N	11	
2.2*	PROCEDURE & WELDER QUALIFICATION	WEDLING PARAMETRES	MA	PHYS. TESTS/RT	100%	IS:7310 / ASME SEC IX	IS:7310 / ASME SEC IX	AS PER ASME SEC IX/QW 483 & 484	√	P	V	V	IN CASE OF NTPC / LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED	
2.3*	WELD SET UPS	DIMENSIONS	MA	MEAS. , VISUAL	100%	WPS, APPD. DRG.	WPS, APPD. DRG.	INSPN. REPORT		P	V			
2.4*	WELDMENTS -FINAL RUN	SURFACE DEFECTS	MA	PT	100%	IS:3658 / ASTM:165	ASME SEC. VIII DIV. I	INSPN. REPORT	√	P	V	V		
2.5	TRUNION / TROLLEY WHEELS, GEARS, PINION	SURFACE FLAWS & INTERNAL FLAWS (FOR DIA. / THICKNESS >50MM)	MA	dpt / UT	100%	ASTME:165	NO LINEAR DEFECTS / NOTE-3	INSPN. REPORT	√	P	V	V		
2.6	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	V	V	FILMS TO BE REVIEWED BY BHEL & NTPC. DPT SHALL BE CHP FOR NTPC & BHEL	
2.7	WHEELS , GEARS AND PINIONS	HARDNESS TEST	MAJOR	HARDNESS	100%	APROVED DRAWING	APPROVED DRAWINGS	INSPN. REPORT	√	P	V	V		
2.8	GEAR BOXES													
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS	MA	MEAS.	100%	MFG. DRG.	MFG. DRG.	INSPN. REPORT	√	P	V			
		CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE.	MA	NO LOAD RUNNING FOR TWO HOUR (VISUAL, MEAS)	100%	MFG. DRG.	NOISE 85dB (MAX), VIBRATION 75 MICRONS (MAX) , TEMP RISE ≤ 20 DEG ABOVE AMBIENT. NO LEAKAGE.	- DO -	√	P	V	V		
2.9	ELECTRICALS													
i	MOTORS	ROUTINE TESTS	MA	ROUTINE TESTS	100%	IS 325	IS 325	MFRS' TEST CERT.,	√	P	V	V	Note: 2	
ii	BRAKES	VERIFICATION OF MAKE, TYPE AND RATING	MA	ROUTINE TEST	100%	IS 3938	IS:3938/TECH. SPEC.	MFRS' TEST CERT.	√	P	V	V		
iii	BRAKE DRUM (IF APPLICABLE)	VERIFICATION OF HT CHARTS, HARDNESS (IF APPLICABLE)	MA	VISUAL, HARDNESS TEST	100%	APPD. DRGS./TECH. SPC.	APPD. DRGS./TECH. SPEC.	HT. CHART /INSPN. REPORT	√	P	V	V		

<div><div>बी एच ई एल</div><div></div></div>		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT					
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		WIRE ROPE ELECTRIC HOIST			
						REV	0	CONTRACT No					
						DATE	Aug-11	CONTRACTOR		BHEL			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
iv	CONTACTOR, TRANSFORMER, O/L RELAYS, HRC FUSES, INDICATING LAMPS, LIMIT SWITCHES , SFU, PUSH BUTTONS MCB ETC	MAKE TYPE AND RATING	MA	VERIFICATION	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	INSPN. REPORT	√	P	V	V	
v	CONTROL PANEL, PENDANT PUSH BUTTON STATION	* FIXING OF COMPONENTS, WIRING, MARKING ,CONTINUITY. * FUNCTIONAL TEST * IR & H.V. TEST * IP - DOP TEST * PAINT SHADE, & THICKNESS, SHEET THICKNESS * ADHESION TEST	MA	VISUAL	100%	IS 3938/APPD.DRG. WIRING DIAGRAM,	IS 3938/APPD. DRG. WIRING DIAGRAM,	INSPN. REPORT	√	P	V	V	BOUGHT OUT ITEMS AS PER BHEL / CUSTOMER APPROVAL LIST. HV OF POWER CIRCUIT AT 2 kV AND CONTROL CIRCUIT AT 1 KV. IR OF POWER & CONTROL CIRCUIT WITH 500V MEGGAR WITH ACCEPTANCE VALUE OF 500 MEGA Ohm/MIN
vi	CABLES	MAKE ,TYPE & RATING AND ROUTINE TESTS	MA	VERIFICATION	100%	AS PER TECH. SPEC. IS:1554/IS:9968- PART - I / IS:694 / RELEVANT IS	AS PER TECH. SPEC. IS:1554/IS:9968- PART - I / IS:694	MNFRS' TEST CERT. & IR	√	P	V	V	
vii	DSL	MAKE , RATING /SIZE , SMOOTHNESS	MA	VISUAL	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC/IR	√	P	V	V	
viii	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V	
3.0	FINAL INSPECTION												
3.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY ,OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	W	CHP
3.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. PERFORMANCE LOAD TEST AT SWL INCLUDING HOISTING ,LOWERING & TRAVEL SPEED, CURRENT DRAWN , INCHING OPERATION , PERFORMANCE OF LIMIT (HOISTING)SWITCHES, CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION	CR	MEAS & VISUAL	100%	IS:3938, APPROVED DRAWING / DOCUMENTS	IS:3938, APPROVED DRAWING / DOCUMENTS	MNFRS' TEST CERT.	√	P	W	W	CHP

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN			PROJECT		MARIB GTPS					
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	WIRE ROPE ELECTRIC HOIST					
				REV		0	CONTRACT No							
				DATE		Aug-11	CONTRACTOR	BHEL						
						PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		D*	M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		**	10			11
		2. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	W		CHP
3.3	OVER LOAD TEST	1. OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, SOUNDNESS OF WELD AFTER OVERLOAD TEST.	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	W		CHP
4.0	PAINTING	PAINT SHADE AND THICKNESS	MI	VISUAL ,MEASURMENT	100%	DRG. & RELV. IS SPEC.	DRG. & RELV. IS SPEC.	MNFRS' TEST CERT.		P	V			
5.0	PACKING	STURDINESS,PROTECTION , MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P				
	NOTE:													
1.0 Clause from 2.1 to 2.4 shall be applicable for load bearing welded joints.														
2.0 For motor rating less than 30 kw:- Acceptance of motor less than 30 kw is based on COC of the manufacturer & the contractor confirming as follows: "It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of NTPC specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between centre of stud and gland plate and tested in accordance with approved drawing/data sheet".														
3.0 Back Wall Echo shall be adjusted to 100% of Full Screen Height in sound (Defect Free) Area. Defect Echo Height more than 20% of Screen Height shall be treated as unacceptable. Back Wall Echo shall not be less than 80% of Screen Height in any case.														
			LEGNDS											
			* RECORDS IDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION											
			** M: MANUFACTURER/SUBCONTRACTOR											
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	C: BHEL/BHEL NOMINATED AGENCY; N: CUSTOMER (CUSTOMER'S NOMINATED AGENCY)												
SIGNATURE			INDICATE 'P' PERFORM"W" WITNESS AND "V" VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN"N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL						

FICHTNER

Volume - II

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 54

conducted. The official holidays or national holidays, and weekly holidays as per the plant/project site shall be followed by the Purchaser's personnel.

For the successful completion of the training program, unless mutually agreed by the parties, the program cannot be interrupted for vacation leave.

To and fro rail/road/airfare of trainees between the place of posting of the trainees and place of training shall be borne by the Purchaser.

8.4.0 Training schedule and program

The program for the Purchaser's personnel will be defined during the liaison meeting.

Two (2) months before the arrival of the first group of the Purchaser's personnel in training site, the Purchaser shall inform the Contractor of the date when the Purchaser's personnel are expected to be sent to training site

Within 2 (two) weeks after receipt of the Purchaser's information mentioned above, the Contractor shall confirm their agreement or indicate difficulties, if any, for the staying of the personnel. Thirty (30) days before the arrival of the Purchaser's personnel in the training site, the Purchaser shall inform the Contractor of the brief career profile of the personnel including names, date of birth, nationality, specialisation, experience, qualification, position and knowledge of foreign languages for their reference / information.

The Contractor shall not charge the Purchaser the costs for the training activities in the respective training sites.

In case the Purchaser fails to send his personnel to attend the above training, the Contract price will be reduced by the equivalent amount as per quoted break-up price by the contractor in their bid.

9.0.0 INSPECTION AND TESTING

9.1.0 General

This section contains general requirements for inspection of material, parts, equipment and workmanship of the plant during manufacture, assembling and erection, upon completion and commissioning to demonstrate compliance with specification, codes and standards to ensure overall reliability of plant operation and performance.

The Purchaser and/or authorised Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the plant items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Purchaser, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Purchaser shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

9.1.1 Scope

FORMT9-P REV-B

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 55

The Contractor has primary responsibility for ensuring the quality of items of equipment supplied under the contract and remains accountable when manufacture or erection is subcontracted. It is therefore a requirement of the specification that work is only subcontracted to companies with effective quality control organizations and that the Contractor monitors the performance of these by the attendance at tests of experienced inspectors employed by the Contractor. The Contractor shall, at the appropriate time, prove that his material and / or equipment comply with all the requirements of the specifications by means of successful completion of tests and inspections. Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.

The Contractor shall provide all necessary means for execution of inspection and testing, according to the requirements.

All materials, components and equipment supplied under the contract shall be subject to inspection by the Purchaser, his representative, any other Inspector of the Government, should they so require during manufacture, erection and after completion. The necessary inspection charges of the inspector shall be borne by the contractor. The inspection and tests shall include but shall not be limited to the requirements of this section of the specification. Further requirements to be applied are specified in the detailed specification.

The type and extent of inspection of items shall be in accordance with the relevant International and other standards approved by the Purchaser, supplemented or amended by the requirements of the specification.

9.1.2 Inspection Program and Test Notifications

Before manufacture commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Purchaser's Representative.

The Purchaser will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent at least 30 days prior to the intended test in accordance with 'Conditions of Contract'. If the Purchaser intends to be represented at the test he will provide at least 72 hours' notice and if his representative does not attend on the notified date, the test may proceed unless an alternative date has been requested by the Purchaser.

Before erection commences and not later than three months before start of erection, the Contractor shall submit the proposed erection test program and the commissioning test program with all proposed erection and commissioning tests and checks. Together with the test programs the proposed test procedures have to be submitted.

The test programs should consider:

- that the sequence and duration of the proposed activities are logical, realistic and in accordance with safety and permit regulations in force
- that the commissioning of any item of plant would not interrupt the normal operation of the existing plant.
- that allowance for training the Purchaser's operation personnel during this period has been made.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 56

The Contractor has to take care that the test programs are maintained by the erection organization during erection and commissioning.

The Contractor has to mark all stages, which are subject to the Purchaser's acceptance and has to notify at least two week's in advance when such inspection for acceptance becomes due.

9.1.3 Test Certificate Documentation

The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

Three copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Purchaser prior to commissioning.

Copies of the performance and acceptance test reports shall be prepared and distributed as specified in Clause 'Performance and acceptance test data and reports' of this Section.

9.2.0 Certification of Equipment by Purchaser's Representatives

The Personal & travelling costs in connection with the Purchaser's Representative engineers inspection and witnessing of tests of equipment, components and material manufactured in Yemen and abroad will be borne by the Purchaser.

9.3.0 Codes and Standards

9.3.1 General

The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by the requirements of this section of the specification. The Contractor should provide the relevant codes and standard to the Purchaser.

9.3.2 Reference to Codes and Standards

Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equalled or exceeded in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Purchaser.

In all instances, the finally accepted applicable code or standard shall be the version last published.

9.3.3 Alternative Standards

Where no appropriate standard is available, tests shall be conducted in accordance with the manufacturer's standard practice, subject to the approval of the Purchaser.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 57

In such cases the Contractor shall submit to the Purchaser, complete data and a suggested procedure for the testing to be performed. Commencement of manufacture before receipt of the Purchaser's approval shall be at the Contractor's risk.

If the proposed procedures are accepted, the Contractor shall provide the Purchaser with four additional copies in English before any test is performed.

9.3.4 Derating Standards

The Contractor's attention is drawn to the climatic conditions in the site area. Derating factors shall apply in accordance with the relevant and approved standards if not specified in the contract documents.

9.4.0 Services prior to and During Inspection and Testing

In accordance with and in addition to specified standards the Contractor shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw materials to the finished product. Manufacture commenced before receipt of the Purchaser's approval of material specifications and testing procedures shall be at the Contractor's risk.

No inspection shall be valid unless the Contractor and manufacturer are in possession of relevant approved drawings and procedures for the item to be tested. The Contractor on request shall supply the Purchaser's representative with a copy of drawings and procedures at the time of the test.

All instruments and apparatus required for the inspection or used for the performance of tests shall be subject to the approval of the Purchaser at his discretion and shall be calibrated to an agreed standard in approved laboratories. The cost of making such calibrations shall be borne by the Contractor in all cases.

If the Contractor wishes to apply for a concession in respect of a departure from an approved procedure or standard, this shall be made in writing with full information substantiating the technical acceptability of the proposed change. The Purchaser's decision shall be final. Concessions granted shall not absolve the Contractor from any of his responsibilities under the Contract.

9.5.0 Quality Control of Materials

9.5.1 General

Materials shall be manufactured and tested in accordance with the specified standards approved by the Purchaser. The attention of the Contractor is drawn to the requirement for witness and certification of these tests by an independent agency and/or by the Purchaser's Representatives.

All materials shall be suitably identified and traceable to supporting test certification.

Material suppliers' certificates of compliance will be acceptable for minor items only at the discretion of the Purchaser.

9.5.2 Major Steel Forging

The Contractor shall prepare material purchase specifications for all major forging but not be limited to, forging for turbine rotors, generator shafts, exciter shafts, large motor shafts, generator end-rings, valves forging, etc.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 58

Purchase specifications shall clearly state the quality and inspection requirements and should include :

- a) Chemical composition range
- b) Heat treatment
- c) Mechanical test specimen locations
- d) Mechanical properties
- e) Magnetic properties (where applicable)
- f) Non-destructive testing
 - methods and procedures
 - stage and extent of application
 - recordable indication size
 - allowable indication size
- g) Thermal stability test (turbine shafts only)
- h) Machining

Each forging shall be suitably marked with an identification number, which shall be transferred throughout all machining stages. The identification number shall be indicated on all documents relating to the forging.

Repair welding shall not be permitted on rotating parts or other components. The proposal for repair welding (if any) shall be subject to approval by the Purchaser.

9.5.3 Major Steel Castings

9.5.3.1 General

The Contractor shall prepare material purchase specifications for all major castings and these shall include but not be limited to turbine casings, large valve and pump casings, etc.

Purchase specification shall clearly state the quality and inspection requirements and should include:

- a) Chemical composition range
- b) Heat treatment
- c) Mechanical test specimen locations
- d) Mechanical properties
- e) Non-destructive testing
 - methods and procedures
 - stage and extent of application
 - recordable indication size
 - allowable indication size
- f) Other tests
- g) Standard weld repair, procedure (for use when the Purchaser's prior approval for repair is not necessary.
- h) Machining

Each casting shall be identified by hand stamped or cast-on reference numbers which shall be indicated on all documents relating to the casting.

9.5.3.2 Non-destructive Testing

Minimum requirements are as follows:

- a) Crack detection of critical areas of castings, which in the case of castings to operate at high temperature or high pressure shall consist of 100% of all accessible areas. Magnetic particle inspection shall be used for ferritic steel castings.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	— Sheet No. 59

- b) Ultrasonic inspection of all surfaces of castings to operate at high temperature or high pressure.
- c) Ultrasonic thickness check of critical areas.
- d) Radiographic examination adjacent to future butt weld regions (Acceptance Standard Level 1 of ASTM E446 or E186 as appropriate).
- e) Radiographic examination shall also be used to assist in defining defects indicated by ultrasonic inspection.

In addition to being applied as necessary quality control on as cast items, inspections outlined in a) and b) above shall be applied to the finally heat-treated castings.

Prior to non-destructive testing, all surfaces shall be satisfactorily prepared and visually examined.

9.5.3.3 Repair Welding

Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be removed by chipping or thermal gouging and grinding, and the complete removal proved by crack detection. In the case of repairs which penetrate more than 25 mm or 50% of the wall thickness or cover more than 100 mm² area, the Purchaser's written approval of the proposed repair shall be obtained.

Only welders qualified by performance tests on similar cast materials shall be employed.

On completion of repair, welded areas shall be ground smooth and carefully blended into the surrounding material. The repaired areas shall be surface crack-detected, with magnetic particle inspection being used for ferritic steel castings, and in addition ultrasonic inspection shall be used on castings to operate at high temperature or high pressure.

9.5.4 Steel Plates and Sections

The following requirements, which may be supplementary to the applicable material standards, shall be considered when selecting material grades:

- Impact testing of plate or sections over 50 mm thick (impact requirements to be dependent on application)
- Ultrasonic testing of plate where the presence of non-metallics may interfere with the interpretation of ultrasonic testing of future welds.
- Ultrasonic testing and through thickness ductility measurement, where the application involves the risk of lamellar tearing in the material at regions of high restraint (e.g. at set-on nozzle locations or cru-ciform joints).
- Ultrasonic testing clad materials to detect lack of bonding. (Proposed rectification procedures shall be submitted for the approval of the Purchaser).

9.5.5 Dished Ends

The requirements of above mentioned clause shall apply to the plate material used.

In addition, the following shall apply to the formed and normalized head:

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 60

- Radiographic or ultrasonic testing of welds to the extent required by the applicable design code of the vessel for which the head is intended. - Crack detection of welds (magnetic particle inspection shall be used for ferritic steels).
- Ultrasonic testing of clad steel heads for lack of bond. The coverage shall be that of a maximum 75 mm grid except in the straight flange within 100 mm of the prepared edge, where coverage shall be 100%.
- Dye-penetrant testing of the inside surface of clad steel ends. The coverage shall be at least representative areas of crown and knuckle and 100% coverage of the straight flange within 150 mm of the prepared edge.
- Tensile test of surplus straight flange material where the plate thickness exceeds 50 mm or the specified minimum tensile strength of the plate material exceeds 450 N/mm². A tensile test at design temperature where this exceeds 350°C shall also be made. Specimens shall be taken from the midwall section and results shall comply with the specified properties of the plate material used.

9.5.6 Thermal Insulating Materials

The Contractor shall submit a list of the materials he proposes to use.

For each application, the following information shall be supplied

- thermal conductivity at operating temperature
- thickness and density
- interface temperatures where layers of dissimilar materials are used.
- amount in m²
- detailed design material specification.

Materials shall be tested for bulk density, specific heat, compressive strength, fire resistance under pressure, and service temperature limit in accordance with approved standards.

All insulation materials shall be asbestos free vermin proof, non-hygroscopic, chemically inert both wet and dry, and fire resistant.

The supply and application of Thermal insulation shall in general, conform to the Detailed Technical Specification.

9.5.7 Testing of Electrical Materials

Unless otherwise agreed, the electrical materials shall be tested in accordance with the following recommendations (latest issues). Alternatively, equivalent standards approved by the Purchaser may be used. The details of the min. tests to be conducted on the electrical equipment are indicated in 9.7.10, Vol. II

Type tests shall be conducted free of cost when type test certificates issued by an independent authority are not available. Type tests shall also be conducted wherever specified.

9.5.7.1 Insulated Cables and Conductors

The insulated cables and conductors shall be tested in accordance with the following rules, regulations and recommendations or approved equivalent standards:

IEC 3035 Thermoplastic insulated weather proof cables.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 61

IEC 502	Extended solid dielectric insulated power cables for rated voltages from 1kV to 30 kV.
IEC 78	Characteristic impedances and dimensions of radio- frequency coaxial cables
IEC 96-O	Radio-frequency cables
IEC 189-1	Low-frequency cables and wires with PVC insulation and PVC sheath - general test and measuring methods
IEC 230	Impulse tests on cables and their accessories.

9.5.7.2 Installation Material

The materials for installation shall be tested in accordance with the following rules, regulations and recommendations or approved equivalent standards:

IEC 130	Connectors for frequencies below 3 MHz
IEC 326	Printed boards
IEC 335	Safety of household and similar electrical appliances

9.5.7.3 Materials for Earthing and Lightning Protection

The materials for the installation of earthing equipment and lightning protection shall be tested in accordance with the relevant IEC Standard.

9.5.7.4 Copper

The copper employed for electrical installations shall be tested in accordance with relevant IEC standards specification for copper for electrical purposes.

9.6.0 Quality Control During Manufacture of Plant

9.6.1 General

The attention of Tenderer is drawn to the requirement in appropriate cases for inspection and certification by an independent agency and/or the Purchaser's Representatives.

9.6.2 Welding

9.6.2.1 General

For all pressure / vacuum containment and major structural welded items, the Contractor shall submit to the Purchaser on request the following documented proposals prior to commencement of welding:

- Welding procedure specifications with qualification records and valid welders' certificates
- Post-weld heat treatment procedures where applicable
- Inspection schedule including quality requirements
- Non-destructive testing procedures
- Standard weld repair procedures.

All welders employed on items of plant for this contract must be qualified.

9.6.2.2 Welding Procedure Specifications

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 62

Welding procedure specifications shall include the following information:

- a) Procedure reference number
- b) Application (alternatively item drawings can be appropriately referenced)
- c) Specification or type of materials to be joined
- d) Range of material thickness and tube diameters to which the procedure applies
- e) Welding processes
- f) Welding position
- g) Sizes and brand names of consumables with nearest equivalent AWS (American Welding Society) designations
- h) Minimum preheat and maximum interpass temperatures
- i) Deposition sequence (including approximate number of runs) with welding current parameters and progression speed
- j) Post-weld heat treatment (if applicable).

Welding procedures shall be qualified in accordance with the requirements of the construction code/specification for the item of plant concerned and in the case of critical plant items, unless otherwise agreed, the tests shall be witnessed by an internationally recognized inspection authority to be approved by the Purchaser. The Purchaser may, at his discretion, accept the results of previously conducted procedure qualification tests provided the essential parameters are still applicable. If, in the opinion of the Purchaser, further qualification tests are required, these shall be conducted at the Contractor's expense.

9.6.2.3 Welder Performance

Welders shall be qualified in accordance with the requirements of the construction code/specification for the item of plant concerned for all types/positions of welding they may perform. The Purchaser may, at his discretion, accept the records of previously conducted performance qualification tests. If in the opinion of the Purchaser further qualification tests are required, these shall be conducted at the Contractor's expense.

Records showing the date and results of the qualification tests performed by each welder together with his identification number shall be available at the work place for examination by the Purchaser's representative.

A system of positively identifying the work of each welder shall be maintained, and any welder whose work is the subject of multiple rejections shall be required to undergo a requalification test. Any welder failing the retest may, at the discretion of the Purchaser, be disqualified from further welding on items under this Contract.

9.6.2.4 Post-Weld Heat Treatment

Welded fabrications shall be stress-relieved when specified by the applicable standard or for dimensional stabilization prior to machining, and one or more written procedures to cover the range of work in a manufacturer's supply shall be submitted by the Contractor.

Procedures shall outline the following:

- a) Method of furnace temperature control
- b) Location of furnace load thermocouples
- c) Heating rates
- d) Holding temperatures and times
- e) Cooling rates.

Copies of temperature charts referenced with load items shall be available for review during inspection visits and shall be included in the test certification supplied for the relevant items.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 63

9.6.2.5 Quality Requirements for Welds

General

All welds shall be visually examined and shall be of smooth contour, free from cracks, undercut and other significant defects. The interior of tubes etc. shall be examined, using a suitable optical device where necessary.

Fillet welds shall be checked for size using suitable gauges which shall be available for use on request by the Purchaser's representative during an inspection visit.

Non-destructive Examination of Pressure and Vacuum Containment Welds :

Welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. In addition, the requirements of Table 9-1 attached to this Specification part shall be observed (fault limitations of relevant construction standard shall apply). Table 9-1 shall also apply in cases where the standards used for design and construction of an item of plant do not specify the quality requirements for welds (fault limitations to be subject to agreement with the Purchaser prior to fabrication).

Non-destructive Examination of Structural Welds :

The welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. Where appropriate, the following requirements shall also be observed:

- Magnetic particle testing of the tension side welds in major fabricated girders and sections.
- Ultrasonic examination of heavily restrained welds (e.g. cruciform joints) where there is a risk of lamellar tearing in the parent material.

9.6.2.6 Weld Repairs

Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be completely removed by chipping or thermal gouging and grinding. The resulting excavation shall be crack-detected prior to rewelding.

One or more standard weld repair procedures shall be submitted to the Purchaser for approval before fabrication commences, and individual requests thereafter for approval of specific cases will only be necessary in the following cases:

- where the depth of excavation of defects exceeds 50% of the section thickness
- where frequent repairs are necessary
- where the cause of repair is cracking
- where two previous attempts at repairing the welds have resulted in unacceptable defects
- where the necessity to repair is discovered after post-weld heat treatment

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 64

- where repair is proposed by a procedure differing from the approved standard procedures.

Details of the original defects and repair shall be recorded.

Repaired welds shall be subjected as a minimum requirement to the same inspection requirements as the original welds and test records should indicate that a repaired weld is referred to.

9.6.2.7 Non-destructive Examination Practice

General

Welds shall be non-destructively examined to the extent specified in the above clause "Quality Requirements for Welds".

Procedures outlining the proposed non-destructive testing practice based on recognized techniques shall be submitted to the Purchaser on request for approval prior to commencement of fabrication.

If necessary welds shall be ground prior to examination.

Radiographic Examination :

X-ray techniques shall be used wherever practical but gamma ray techniques may be used provided that adequate sensitivity can be demonstrated. The sensitivity of radiographic films shall be 2% or less as indicated by the image quality indicator for density grade between 2 and 3.

Personnel engaged in radiography shall hold an appropriate certificate of competency (e.g. CSWIP or SNT-TC-IA or equivalent, the approval of which shall be at the discretion of the Purchaser).

The following shall be clearly visible on each radiograph:

- Penetrameter(s)
- Job reference number
- Weld reference number
- Serial number denoting location in length of weld
- Symbols referencing location with markings on actual weld
- Identification R1, R2 etc. denoting first repair, second repair etc.

Reports of examinations shall include the following :

- Item of equipment and job reference number
- Weld reference number and locations examined
- Heat treatment condition
- Procedure used for examination (this can refer to a standard procedure but must contain actual technique and exposure parameters used, contrasts and sensitivities obtained.)

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 65

- Location, dimensions and types of recordable indications and their acceptability with respect to the applicable fault limitation standard shall be made for all examinations.

Radiographic films shall be safely stored for a minimum of five years.

Ultrasonic Examination :

Personnel engaged in ultrasonics shall hold an appropriate certificate of competency (e.g. CSWIP or SNT-TC-IA or equivalent, the approval of which shall be at the discretion of the Purchaser).

Reports of examinations shall include the following:

- Item of equipment
- Weld identity and type
- Heat treatment condition
- Procedure used for examination (this can refer to a standard procedure but must contain details of equipment, its actual calibration and settings, and technique of scanning)
- Location, dimensions and type of recordable indications and their acceptability with respect to the applicable fault limitation standard.

Magnetic Particle Examination :

The current flow technique using wet or dry media shall be used, though the latter is preferred on non-machined surfaces. Where necessary, contrast aid paints shall be applied to the weld surface prior to examination. Prod separations shall not exceed 25 mm per 100 amps current developed.

Arcing during test shall be minimized and burns removed afterwards by grinding.

Personnel engaged in magnetic particle inspection shall be suitably experienced and should preferably hold a recognized certificate of competency in this technique.

Reports of examinations shall include :

- Item of equipment
- Weld identity and locations of examination
- Heat treatment condition
- Weld surface condition
- Procedure used for examination (this can refer to a standard procedure but must include type of magnetic medium used)
- Location dimension and type of recordable indications and their acceptability with respect to the fault limitation standard.

Dye-Penetrant Examination

Dye-penetrant examination may be used for intermediate checks (e.g. back-gouging of first side welds) and for final examinations of austenitic stainless steel, non-ferrous materials, and items whose geometric form does not permit magnetic particle inspection.

Penetrants of either water or solvent soluble type may be used. Only low halogen, low-sulphur grades shall be used on nickel alloys.

Personnel conducting dye-penetrant examination shall be suitably experienced.

Reports of examinations shall include the following :

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 66

- Item of equipment
- Weld identity and locations of examination
- Heat treatment condition
- Weld surface condition
- Procedure used for examination (this can refer to a standard procedure but must include type of consumables used)
- Location, dimensions and type of recordable indications and their acceptability with respect to the applicable fault limitation standard.

9.6.3 Pressure Testing

9.6.3.1 General

All items subjected in service to internal pressure or vacuum shall, unless otherwise agreed, be pressure-tested prior to any internal or external coating. Where practical and unless otherwise agreed by the Purchaser, vacuum containment plants shall also be vacuum-tested.

Test procedures shall be subject to approval by the Purchaser on request. Unless otherwise agreed hydrostatic pressure testing shall be used.

9.6.3.2 Hydrostatic Testing

General

Suitable quality of water shall be used as the test medium unless otherwise agreed, and test pressures shall be in accordance with the applicable construction standard but if none is specified then the test pressure shall be 1.5 times the design pressure but not less than 350 kpa(g). Test pressure of vacuum containment items shall be agreed with the Purchaser.

The test pressure shall be maintained for sufficient time to permit complete visual examination of all surfaces and joints and in no case less than specified in the applicable construction standard.

The chloride content of water used for testing austenitic stainless steel items shall not exceed 30 ppm. Immediate flushing with water of this quality after the test is requested.

Water temperatures shall not be less than 7°C during tests and the use of higher temperatures to avoid brittle fracture in heavy walled vessels shall be considered by the manufacturer.

Precautions shall be taken to avoid damage of expansion bellows and other fittings during testing.

Adequate drying and cleaning of items to prevent deterioration shall be made in appropriate cases following testing.

Valves

Valves shall be pressure-tested in accordance with AP1 598 or equivalent standard and unless otherwise agreed, this shall include both body and seating and one valve per

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 67

type/size/ manufacturing subject to closure test . For valves higher than PN 40, each valve shall be subject to shell, seat and closure tests.

9.6.3.3 Pneumatic Testing

The Contractor shall propose pneumatic testing in cases where hydrostatic testing is impractical or undesirable. Safety precautions, test pressures / duration and degree of prior non-destructive examination of the subject items shall be agreed with the Purchaser.

Pneumatic or gas leak testing supplementary to hydraulic testing shall be applied in appropriate cases where specified by the applicable construction standard.

9.6.3.4 Alternatives to Hydrostatic and Pneumatic Testing

Alternative methods to hydraulic or pneumatic testing for proving the integrity of pressure and vacuum containment plant shall be subject to agreement with the Purchaser.

9.6.4 Testing of Surface Coatings

9.6.4.1 Galvanized Zinc Coatings

Surfaces shall be visually inspected. Bare patches, lumps, blisters or inclusions of foreign matter shall be cause for rejection

Zinc coating thickness shall be determined non-destructively in accordance with DIN 50981 or coulometrically in accordance with DIN 50932 or equivalent standard. For coatings with a weight exceeding 900 g/m^2 , the coulometric test method specified in DIN 50932 or equivalent shall be used.

9.6.4.2 Hard Rubber Linings

The thickness of hard rubber linings shall be in accordance with VDI Standard 2539 or equivalent. A tolerance of + 10 % is permitted for rubber coatings of 3 mm nominal thickness.

The absence of pores shall be proved by the induction sparking test method. The potential used shall be 5000 Volts for each mm of thickness plus an additional 5000 Volts (i. e. potential of 20,000 Volts for 3 mm thick lining).

Surfaces shall be visually inspected. Uneven surfaces, splits, blisters or inclusions of foreign matter shall be cause for rejection.

Hardness tests shall prove compliance with the rubber manufacturers' standards.

9.7.0 Tests on Completed Equipment in The Manufacturer's Works

9.7.1 General

Equipment shall wherever practical be subjected to tests on completion in the manufacturer's works to prove that the reliability, operation and performance conform to the requirements of this specification and the provisions of the appropriate standards.

The Contractor shall on request submit for approval procedures describing the proposed test methods to be used, type and layout of test facility, location of instrumentation, formula for

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 68

calculation of results and correction to site conditions etc. shall be included where appropriate.

All measuring instruments used in tests shall be regularly calibrated and records shall be available for examinations by the Purchaser or his representative.

The electric motor used for driving equipment during test, shall wherever possible be the service motor for that item. In all cases performance certificates for the motors used shall be available for examination by the Purchaser or his representative and shall be included in the certification produced for the item tested.

9.7.2 Rotating Units

9.7.2.1 Static and Dynamic Balancing of Rotating Units

Each rotating unit shall be first statically balanced and then dynamically balanced (in the case of impellers this shall be done before and after mounting of the service rotor shaft). A check balance of items that have undergone overspeed testing shall also be made.

The standards for dynamic balance shall be specified by the Contractor subject to agreement by the Purchaser.

9.7.2.2 Vibration Testing of Rotating Units

The vibration characteristics of rotating units shall be measured during the performance test. Locations of measurement and standards to be achieved shall, on request, be subject to agreement by the Purchaser.

9.7.3 Pumps

Running tests and, unless otherwise agreed with the Purchaser, performance tests shall be conducted on all pumps.

Performance tests in accordance with standards (PTC, ASME, BS, DIN) by the Purchaser shall be conducted through the full operating range of the pump to closed valve conditions. Graphs indicating Flow/Head, Flow/Power absorbed, Flow/Efficiency, Flow/NPSH and speed shall be provided for each pump.

The lubricating oil used in the test shall be of the same brand and grade as that recommended by the manufacturer for service use.

Dismantling of the pump for visual examination of parts for damage following the test shall be done when required by the inspection standard, when considered necessary by the manufacturer, or when requested by the Purchaser or his representative witnessing the running or performance tests. Replacement of parts following test shall, unless otherwise agreed with the Purchaser, necessitate repeat testing.

9.7.4 Gas Turbines

All equipment and components of gas turbine generator shall be tested at manufacturer's works in accordance with the manufacturer's standard methods and procedures as necessary

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 69

to ensure high quality materials and equipment, reliable and safe operation, and long life. Copies of the manufacturer's quality assurance programme, manufacturing test description and pre-shipment operating test descriptions shall be submitted in advance of the start of fabrication, along with a listing of the test reports to be provided to the Purchaser and a schedule of each. Example copies of representative key test reports shall also be provided.

A no-load operational test shall be made for the turbine. All control and safety devices shall be checked for proper operation during this test.

The following items shall be checked during no-load operation of the turbine :

- Bearing oil temperature rise
- Vibration levels over the operating speed range
- Exhaust temperature
- Wheel space temperature
- Fuel system operating characteristics
- Overspeed trip
- Coolant system
- Air flow & pressure ratio
- AOP cut-in and cut-out pressures

- Individual accessories, including heat exchangers for lube oil and water, solenoid valves, stop valves, control valves, pumps, motors, ignition system, gauges, thermocouples, heaters and electric switches.

Prior to the no-load test, all pressure containing parts shall be hydrostatically tested at 1.5 times the design pressure. The turbine and compressor rotors shall be precision balanced before being fitted into the turbine stator and the turbine and generator rotor shall also be tested for a minimum of 120% rated speed for about five (5) minutes.

9.7.5 Fans

All fans shall be tested in accordance with the applicable standards.

The particular test procedure to be applied to each type of fan shall be agreed with the Purchaser. The tests shall be conducted strictly to the requirements of the agreed test procedure so that all points on the performance curves are within agreed tolerances.

9.7.6 Compressors

Compressors shall be tested in accordance with the requirements of ISO 1217, API, ASME, PTC-9 or VDI 2045 sheets 1, 2 and 3 or similar approved standards. Any request for deviation from the test conditions shall be accompanied by the manufacturer's proposals for the adjustment of the correction factors contained in the standard. Unless otherwise approved by the Purchaser, tolerances will be allowed according to ISO/R 541.

Simulation of actual working conditions shall be attempted during testing in the manufacturer's works wherever practical. If actual working conditions cannot be maintained, correction factors shall be applied in accordance with the applicable standard and based on the general rules of thermodynamics.

The control and alarm systems of equipment manufactured in workshops shall be tested by simulating the actual working conditions. Such tests will not release the Contractor from performing them again, as required, at site.

9.7.7 Cranes and Hoists

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	— Sheet No. 70

Deflection tests on crane girder at 1.25 times the working level shall be conducted as per relevant codes. Where size permits cranes and hoists shall be completely assembled at the Manufacturer's works and functional tests conducted to the satisfaction of the Purchaser's representative.

9.7.8 Electrical Equipment

Unless otherwise agreed the electrical equipment shall be tested in accordance with the relevant IEC standards or other relevant international standards (latest issue) not limiting to the following. The standards shall include all the amendments made to the issues. Alternatively, equivalent standards approved by the Purchaser may be used. Type tests shall be conducted free of cost, if type test certificates issued by an independent test authority are not made available. Routine tests as per relevant standards and also tests as per manufacturer's standards shall be performed on all electrical equipment whether specifically listed or not. Some of the specific tests required are listed below:

9.7.8.1 Generator

All tests shall be conducted by the Bidder, at his expense, to demonstrate the capability, guaranteed performance and compliance with the specification.

Shop Tests

All equipment and material shall be subjected to manufacturer's standard shop tests. Tests shall be carried out at the manufacturer's works during and after completion of manufacture of different component parts in accordance with the requirements of relevant codes, and wherever not specified in the said codes/regulations, the tests shall be carried out in accordance with the standards approved by the Purchaser.

Factory tests of components shall include, but not be limited, to the followings:

- a) Material analysis and testing
- b) Static and dynamic balance tests of all rotating parts, at specified overspeed and to determine the mass center and vibration level.
- c) Radiographic, Magnaflux and other non-destructive testing.

The generator and its accessories shall be subjected to all the routine tests including the following tests with test procedures as per the codes and standards adopted for the equipment, in presence of Purchaser's representative :

- a) Measurement of DC resistance of stator & rotor windings
- b) Measurement of insulation resistance of stator winding and rotor winding (before & after high voltage tests), bearings & embedded temperature detectors.
- c) High voltage test
- d) Overspeed
- e) Pressure tests on coolers for closed circuit cooling
- f) Determination of efficiency by separation of losses methods
- g) Vibration

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 71

- h) Impedance test for rotor winding
- i) Measurement of tan delta & capacitance of stator windings at rated voltage.
- j) If type test certificates can not be produced for following tests, the same shall be conducted on a machine of similar design :
 - i) Instantaneous short-circuit test
 - ii) Determination of reactance and time constants
 - iii) Voltage wave form

Exciter Tests

The excitation system and its accessories shall be subjected to all the routine tests including temperature rise test of AC exciter with test procedures as the codes and standards adopted for the equipment, in presence of Purchaser's representative.

Site Tests on Generator & Accessories

For Generator, site tests shall be included but not limited to the following:-

Mechanical

- a) Vibration test
- b) Overspeed trip test

Electrical

- a) Measurement of DC resistance
- b) Drying out test
- c) High voltage test
- d) Short circuit and open circuit tests
- d) Phase sequence test
- e) Temperature rise test

For exciter, site tests shall include but not limited to the following :-

- a) Measurement of DC resistance
- b) Measurement of insulation and drying out test.

9.7.8.2 HV Busdcuts

All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

Routine Test

Bus Duct shall be subjected to the following tests :

- a) Visual inspection and verification of dimensions.
- b) Dry power frequency voltage withstand for 1-minute.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 72

- c) Milli-volt drop test.
- d) Water tightness test.

Type Test

- a) Impulse voltage withstand on a typical section of bus duct including one bend.
- b) Heat run test on representative sections of 3 phase bus duct, including one bend and flexible joints.
- c) Short circuit test on representative sections of 3 phase bus duct, including one bend. The sections having longest span between support insulators shall be chosen.

Auxiliary Equipment

- a) All component parts and auxiliary equipment such as current transformer, voltage transformer, neutral grounding transformer, lightning arrester, surge capacitor, insulator etc. shall be routine tested as per relevant International Standards.
- b) All cubicles shall be completely wired up at the factory and subject to wiring check and power frequency withstand tests on control/ secondary wiring.

9.7.8.3 HT / LT Transformers

The transformer shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

Routine Tests

During manufacture and on completion, all transformers shall be subjected to routine tests as per IEC Standards. In addition, the following tests shall be performed on each transformer :

- a) Transformer tank with coolers shall be tested for oil leaks with normal head of oil plus 35 KN/sq.m. measured at the base of the tank for a period of 12 hours. If any leak occurs, the test shall be conducted again after all leaks have been repaired.
- b) The tank designed for full vacuum shall be tested at an internal pressure of 3.33 KN/sq.m. (25mm of Hg) for an hour.
- c) After assembly, each core shall be pressure tested for one minute at 2 KV A.C. between all bolts, side plates, structural steel works and the core.
- d) Excitation loss and current measurements shall be made at 90%, 100% and 110% of the rated voltage.
- e) Partial discharge test (for dry type transformer only)

Type Tests

Following type tests shall be performed on the transformer in accordance with relevant standard :

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 73

- a) Impulse withstand test
- b) Temperature rise test.
- c) Over voltage test as a proof to withstand capability due to sudden load throw-off (applicable for Generator Transformer only)

Miscellaneous

All component parts and auxiliary equipment such as oil, bushings, CTs etc. shall be routine tested as per relevant standards.

9.7.8.4 Switchgear 6.6 kV / 400 V / MCC / DB

All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

Routine Test

The tests shall include but not necessarily limited to the following:

- a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- b) All wiring and current carrying part shall be given appropriate High Voltage test.
- c) Primary current and voltage shall be applied to all instrument transformers.
- d) Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, relays, meters, transducers, switchfuse, contactors, meters etc.

Type Test

The following test shall be performed on a typical section of the bus assembly:

- a) Impulse Test (Only for 6.6 kV switchgear)
- b) Temperature rise Test
- c) Short circuit Test (optional)

9.7.8.5 DC System

All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standard.

Shop Tests

- a) Type tests on two cells of each battery.
- b) Tests on Battery Charger
 - i) Dielectric tests.
 - ii) Voltage regulation check from 0 to 100% load with $\pm 10\%$ input voltage

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 74

variation.

- iii) Ripple content measurement.
- iv) Heat run test on current limiting value.
- c) Routine tests on component parts

9.7.8.6 Electric Motors

Upon completion, each motor shall be subjected to standard routine tests as per relevant standards. In addition, any special test called for in the driven equipment specification shall be performed.

The following type tests shall be performed on a representative sample of 6600V motor of each type & rating, even if type test certificates of these tests are submitted by the Bidder for Purchaser's approval.

- a) Measurement of stator resistance and rotor resistance on slip ring motors.
- b) No load running of motor and reading of voltage, current, power input and speed.
- c) Locked rotor reading of voltage, current, power input and values of torque of motor.
- d) Full load reading of voltage, current, power input and slip.
- e) Temperature rise test.

9.7.8.7 Actuators

The actuator and all components thereof shall be subject to routine factory tests as per relevant standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.7.8.8 Illumination System

Shop Tests

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

Tests on lighting distribution boards/panels shall include :

- a. Wiring continuity tests.
- b. High voltage and insulation tests.
- c. Operational tests.

Site Tests

The Bidder shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	— Sheet No. 75

If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

Illumination in different areas is as per designed lux level.

9.7.8.9 Earthing & Lightning Protection System

After installation of the complete plant grounding system the Bidder shall measure the total ground resistance. If the measured value comes one ohm or more, the Bidder shall modify their design in order to active the required values of the total ground resistance.

9.7.8.10 Communication System

All the equipment of the plant communication System shall be completely assembled, wired, adjusted and tested at the factory for operation under simulated conditions as per relevant standards to ensure accuracy of wiring, correctness of control scheme and proper functioning.

Routine Test

Routine tests for all the equipment under this specification shall be performed as per applicable clauses of relevant standards.

Type test

Type test certificates conforming to the relevant standards conducted to identical equipment shall be furnished, in absence of which manufacturer shall conduct the type tests on the equipment as per relevant standards without any extra cost.

9.7.8.11 UPS System

All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

Shop Tests

- a) Type and routine test for various components.
- b) Functional tests to demonstrate compliance with all specified requirements and published specifications such as frequency regulation, voltage regulation, current limiting, fuse clearing capability of inverters, demonstration of phase and frequency control of inverter for synchronization with range of adjustments, tests transfer and re-transfer of static switches under influence of under voltage and over current, on chargers, batteries and other system component to confirm compliance with specification.
- c) All equipment provided under the specification shall be operated under rated conditions and maximum ambient temperature for not less than 120 hours prior to release of shipment.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	— Sheet No. 76

In addition static switches shall be subjected to not less than 1000 transfer/re-transfer cycles at full load.

9.7.8.12 Control & Relay Panel

Each protection panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment.

Routine Tests

The tests shall include wiring continuity tests, insulation tests and functional tests to ensure operation of the control/protection schemes and individual equipment.

All switches, relays and other devices shall be tested and calibrated in accordance with relevant IEC standards.

9.7.8.13 Power & Control Cables

Shop Tests

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

- Routine tests on each drum of cables
- Acceptance tests on drums chosen at random for acceptance of the lot
- Type tests on each type of cable, inclusive of measurement of armour D.C. resistance of power cables

Additional Tests

Each type of cable shall also be subject to the following additional type tests at works.

- Oxygen index test as per ASTM D 2863. Minimum value of Oxygen index shall be 29 for FR cables. For Fire-survival cables, the minimum value of Oxygen index shall be 30.
- Flammability tests on finished cable as per the requirements of IEEE-383, IEC-332-3 Category-C and Swedish standard SS 4241475 clause F3.
- Smoke generation by outer sheath under fire as per ASTM D 2843. The FR cables shall meet the requirements of light transmission of minimum 40 % during test. In case of Fire-survival cables, the minimum requirement of light transmission during test is 80% .The test shall be carried out by extrapolation method beyond temperature at which the material of the sheath may start deformation, as per BICC hand-book Chapter-6 on cables in fire. The minimum value of temperature index shall be 250 Deg. C.
- Acid gas generation by outer sheath under fire as per IEC-754-1 and the maximum Acid gas generation shall be 20 % by weight for FR cables, and the same for Fire-survival cables shall be 2 % by weight.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	— Sheet No. 77

9.7.8.14 Miscellaneous Electrical Items

Local Control Panels/Local Push Button Station/Local Junction Boxes shall be completely assembled, wired adjusted and tested for operation to ensure accuracy of wiring, correctness of control scheme and proper functioning of all components.

The Bidder shall conduct all tests on the equipment under the specification as per the relevant standards.

9.7.8.15 Electrical Installation

Schedule of pre-commissioning tests:-

Transformer

- a) Drying out by using Stream line filter, centrifuge and heater set
- b) Dielectric test of oil
- c) Insulation resistance of oil in both main and OLTC chamber.
- d) Insulation Resistance of windings
- e) Checking of Phase Sequence Test
- f) Continuity Test
- g) No load voltage ratio at all tap positions
- h) Checking of Vector Group
- i) Tap changer operation check (Mechanical and Electrical) including indication and alarm circuits.
- j) Magnetising Current Check at 400V, 3 ph., 50 Hz, supply for all the three phases.
- k) Measurement of Winding resistance
- l) Cooler control, indication and alarm circuits
- m) Breather (Check for Silicagel)
- n) Buchholz relay operation
- o) Low oil level for Main tank/OLTC chamber
- p) Physical line connections as per phasing diagram
- q) Neutral connection to earth effectively.
- r) Calibration of different temperature indicators, relays and switches.

Circuit Breaker

- a) Insulation resistance test on each pole by H.V. Meggar.
- b) Insulation resistance test on control circuit.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 78

- c) Dielectric test of oil.
- d) Checking of all joints for gas leakage in case of SF6 insulated breaker.
- e) Measurement of contact resistance for all the Three Phases.
- f) Checking the auxiliary circuits associated with circuit breaker.
- g) Functional check of breaker operation electrically at 70% and 110% of rated D.C. supply voltage.
- h) Checking of Interlocks provided in Control Circuits and tripping through simulated protective relay contacts.
- i) Auto-reclosing duty cycle check wherever auto-reclosing is required.
- j) Measurement of resistance of closing and tripping coils.

Current Transformer

- a) Insulation Resistance test on each winding by Meggar to earth and between windings.
- b) Checking of all ratios on all cores by Primary injection set.
- c) Polarity check on each winding.
- d) Continuity test
- e) Check for connection to correct taps.
- f) Oil level check

Potential Transformer

- a) Checking of voltage ratios on all windings.
- b) Polarity checking on each winding.
- c) Insulation resistance test on each winding by Meggar to earth and between windings.
- d) Check for connection to correct taps.
- e) Oil level check

Lightning Arrester

- a) Check for connections to ground and line.
- b) Continuity check (in case of Metal Oxide Silicon type only).
- c) Operation check of discharge counter.

Grounding

- a) Continuity of grounding connection.
- b) Testing of Earth Resistance of Individual Electrode.

***Data sheet –A/B: EOT Crane (with VVVF drives) including crane
clearance diagram PE-DG-372-501-A001 Rev 00***



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 1 of 15

DATA SHEET FOR TG HALL EOT CRANE WITH VVVF DRIVES

* Information's are to be furnished by bidder during contract stage

Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS
1.0.0		General	
1.1.0		Name of manufacturer	*
	a.	EOT Crane	*
	b.	Crane motors	*
	c.	Runway conductors	*
1.2.0		Weight of equipments	
	a.	Bridge assembly	*
	b.	Trolley assembly	*
	c.	Total crane weight	*
	d.	Total weight of the gantry rail	*
	e.	Total weight of DSL	*
	f.	Total weight of all the equipments under this specification	*
1.3.0		Design, fabrication and testing of the crane confirm to standard / code number	IS:3177-1999 & IS 807 (Latest edition) , Telescopic hoist standard confirming to IS 3938(latest edition).
1.4.0		Number of cranes	One
1.5.0		Crane classification	M5
1.6.0		Suitable for outdoor or indoor duty	Indoor
1.7.0		Capacity and lift	
1.7.1		Main hoist	
	a.	Rated SWC – tonnes	60
	b.	Test load SWC – tonnes	60 and overload test 75 T
1.7.2		Aux. hoists	
	a.	Rated SWC – tonnes	16



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 2 of 15

	b.	Test load SWC – tonnes	16 and overload test 20 T	
		Capacity – Telescopic hook		
		Rated SWC – tones	10	
		Test load SWC – tones	10T and overload test 12.5T	
1.8.0		Span	10700 mm	
1.9.0		Operation from	Cabin , pendant push button station & radio remote control.	
2.00		Crane Performance		
2.1.0		Crane speed with full load	Full speed M/Min	Creep speedM/Min
	a.	Main hoist	1.2	0.12(Through VVVF drive)
	b.	Aux. hoist	5	0.5 (Through VVVF drive)
	c.	Telescopic hoist	3 to 4	0.3 to 0.4(Through VVVF drive)
	d.	Trolley travel (CT)	10	1.0 (Through VVVF drive)
		Longitudinal bridge travel (LT)	15	1.5 (Through VVVF drive)
2.2.0		Acceleration values	LT motion (bridge travel)	CT motion (trolley travel)
			As per IS: 3177	As per IS: 3177
2.3.0		Lift in Metres		
	a.	Main Hoist	Refer crane clearance diagram	
	b.	Aux Hoist	Refer crane clearance diagram	
	c	Telescopic Hook	Refer crane clearance diagram	
2.4.0		Hook Approaches in Metres		
	a.	Main hoist (cabin end)	Refer crane clearance diagram	
	b.	Aux. hoist (cabin end)	Refer crane clearance diagram	
	c.	Telescopic hook (cabin end)	Not Applicable	
	d.	Main hoist (other end)	Refer crane clearance diagram	
	e.	Aux. hoist (other end)	Refer crane clearance diagram	
	f.	Telescopic hook (other end)	0.265 beyond L T Rail centre	
2.5.0		Hand Rail Pipes	32 mm NB Medium class of IS: 1161 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)	
3.0.0		COMPONENT DETAILS		



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 3 of 15

3.1.0		Trolley			
	a.	Type	Fabricated		
	b.	Method of fabrication	Fusion welded		
	c.	Material	IS: 2062 Gr. A up to 20mm thickness, Grade B Normalized for thickness above 20mm. High steel alloy steel confirming to IS: 8500 is also acceptable.		
	d.	Centre to centre distance of wheels (on the same rails)	*		
	e.	Whether jacking pads for lifting trolley provided or not	Yes / No		
3.2.0		Rope drums	Main hoist	Aux. Hoist	Telescopic hoist
	a.	Dimensions in mm length and diameter (PCD)	During detailed engineering	During detailed engineering	
	b.	Material (Indicate IS)	Seamless pipe ASTM -106 or fabricated Fe410w IS: 2062 & stress relieved		
	c.	Flange / flangeless	Flanged		
	d.	Numbers provided	One for each hoist		
	e.	Number of grooves	*	*	
	f.	Type of grooves	Identical Right hand and Left hand		
	g.	Diameter on bottom of grooves	During detailed engineering	During detailed engineering	
3.3.0		Rope details			
	a.	Construction	Extra flexible plough steel , 6 x 36 / 6 x 37 construction		
	b.	Grade	During detailed engineering		
	c.	Standard conforming to	IS: 2266		
	d.	Diameter in mm	*	*	
	e.	Breaking strength	*	*	
	f.	Tensile designation	*	*	
	g.	Factor of safety	5.25 as per IS	5.25 as per IS	
	h.	Type of core	Fibre	Fibre	
	i.	Number of falls	*	Min. 4	
	j.	Length of rope	*	*	
3.4.0		Sheaves details	Main hoist	Aux. Hoist	Telescopic hoist



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 4 of 15

	a.	Material	Fe 410 WA IS: 2062 Gr. A or B/ CS Gr. 280-520 IS: 1030				
	b.	Diameter of main sheaves in mm on Root	During detailed engineering		During detailed engineering		
	c.	Diameter of Equalizing sheaves (in mm) on Root	Should not be less 62% of calculated main sheave diameter		Should not be less 62% of calculated main sheave diameter		
	d.	Type of guards provided	Fabricated from Sheet steel				
3.5.0		COUPLINGS & SHAFTING					
3.5.1		Coupling details (between motor and gear box)	Main hoist	Aux. Hoist	Cross Travel	Long Travel	Telescopic hoist
	a.	Type	Flexible geared Type				
	b.	Size & Torque rating	*				
	c.	Guards and enclosures	Provided				
3.5.2		Coupling details (between gear box and wheels)	Cross Travel (CT)		Long Travel (LT)		
	a.	Type	Flexible geared type				
	b.	Size & Torque rating	*				
	c.	Guards and enclosures provided	Yes				
3.5.3		Coupling details (between gear box and rope drum)	Main hoist		Aux. Hoist		
	a.	Type	Flexible Built-in gear couplings				
	b.	Size	*				
	c.	Guards and enclosures provided	Yes				
3.5.4		Shafting (Output)	Cross Travel		Long Travel		
	a.	Diameter in mm	*		*		
	b.	Factor of Safety	As per IS: 3177-1999				
	c.	Number of support bearings	*		*		
	d.	Type of support bearing	*		*		
	e.	Arrangement of lubrication	Grease cups / Nipple				



**TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES**

MARIB GTPS

**DATA SHEET A/B
(WITH VVVF DRIVES)**

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 5 of 15

	f.	Type of lubricant	Grease		
	g.	Max unsupported length of shaft in mm	*	*	
3.6.0		Gear box details			
3.6.1		Hoist Motions	MH	AH	Telescopic hoist
	a.	Type of mounting of gear box	Horizontal / Vertical		
	b.	Classification	Suitable for M5 duty		
	c.	Total number of reductions	3	3	
	d.	Type of gears	Helical	Helical	
	e.	Reduction ratio	*		
	f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication		
	g.	Hardness (BHN) – gear	*		
	h.	Hardness (BHN) – pinion	*		
	i.	Difference in Gear and pinion hardness	Min 20 BHN		
	j.	Materials (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/ EN 24. Hardness conforming to IS: 3177		
	k.	Castings	Fabricated Fe 410w IS: 2062 & stress relieved		
	l.	Noise level	85 db	85 db	
	m.	Standard conforming to	IS: 4460 / AGMA		
3.6.2		Travel Motions	CT	LT	
	a.	Type of mounting gear box	Vertical		
	b.	Classification	M5 duty		
	c.	Total number of reduction	3	3	
	d.	Type of gears	Helical	Helical	
	e.	Reduction ratio	*	*	



**TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES**

MARIB GTPS

**DATA SHEET A/B
(WITH VVVF DRIVES)**

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 6 of 15

	f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication		
	g.	Hardness (BHN) – gear	*		
	h.	Hardness (BHN) – pinion	*		
	i.	Difference in Gear and pinion hardness	Min 20 BHN		
	j.	Materials (gear / pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/ EN 24. Hardness conforming to IS: 3177		
	k.	Castings	Fabricated Fe 410w IS: 2062 & stress relieved		
	l.	Standard conforming to	IS: 4460 / AGMA		
3.7.0		Wheels details	Cross travel	Long travel	
	a.	Material	C 55 Mn 75 / EN 9 (55 C 8)		
	b.	Hardness	300 – 350 BHN		
	c.	Depth of hardness	10 mm (min)		
	d.	Tread diameter in mm	*	*	
	e.	Tread width in mm	*	*	
	f.	Process of hardening	Volume hardening		
	g.	Type	Double flanged straight tread		
	h.	Numbers provided	4 nos.	8 nos.	
	i.	Specification conforming to	IS: 3177		
	j	Arrangement of lubrication	Grease		
			Harness of wheel for telescopic hoists shall be as per IS 3938 (Latest edition).		
3.8.0		<u>Lifting hooks</u>	MH	AH	Telescopic hoist
	a.	Type	Ramshorn	‘C’ type	‘C’ type
	b.	Safe lifting capacity	60 T	16 T	10 T
	c.	Material	Class 2 IS: 1875		
	d.	Standard conforming to	IS:5749	IS:15560	IS:15560
	e.	Hook can rotate	Yes		
	f.	Safety latch on hook provided	Yes		



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 7 of 15

	g.	Locking device on swivelling hook required or not	Provided		
3.9.0		Buffers	Cross travel	Long travel	
	a.	Type	Spring loaded type. To be designed to bring the loaded crane to rest from speed of 50% of the rated speed.		
	b.	Numbers provided	4	4	
	c.	Details of end stop	Fabricated Fe 410w IS: 2062		
3.10.0		Brakes			
3.10.1		Hoist Motions	MH	AH	Teleopic hoist
	a	Type of brake (ac / dc / thruster)	AC Electro-Hydraulic Thruster operated		DCEM Disc brake for telescopic hoist
	b.	Diameter of brake in mm	*	*	*
	c.	Torque rating Kg. M	*	*	*
	d.	Number provided per motor	2	2	1 no. per motor for telescopic hoist
	e.	Braking capacity	150%	150%	150%
	f.	Braking torque actually required	*	*	*
	g.	Material			
		• Brake liners	Ferrodo liners		
		• Drum	CS IS : 1030 / CL 4 IS : 1875		
		• Springs	As per manufacturers standard		
	h.	Braking distance in mm	*		
3.10.2		Travel Motions	CT	LT	CT for Telescopic hoist
	a.	Type of brake (ac / dc / thruster)	AC Electro-Hydraulic Thruster operated		DCEM Disc brake for telescopic hoist
	b.	Dia of brake in mm	*	*	*
	c.	Torque rating Kg.M	*	*	*



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 8 of 15

	d.	Number provided	2			2	1 no. per motor for telescopic hoist	
	e.	Braking capacity	125%			125%	125%	
	f.	Braking torque actually required	*			*	*	
	g.	Material						
		<ul style="list-style-type: none">Brake liners	Ferrodo liners					
		<ul style="list-style-type: none">Drum	CS IS : 1030 / CL4 IS : 1875					
		<ul style="list-style-type: none">Springs	As per manufacturers standard					
		<ul style="list-style-type: none">Thrusters	*					
	h.	Braking distance in mm	*			*	*	
3.11.0		Drive system for hoisting						
	a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box					
	b.	Arrangement of drive from pony motor to rope drum (creep speed)	NA					
3.12.0		Bearings	Crane hook	Trolley wheels	Rope drum	Gear box	Any other assembly	
	a.	Type	Antifriction ball / roller bearings					
	b.	Number provided for each	As per assembly requirements					
	c.	Method of lubrication	Grease lubrication					
	d.	Bearing life	10,000 working hours.					
3.13.0		Bridge girder						
	a.	Type & Quantity	Box type – 2 nos. Material: IS 2062 Gr. A / B					
	b.	Size	*					
	c.	Vertical Deflection	Span / 900					
	d.	Type of connection to end carriage	By fitted bolts					
	e.	Width	*					
	f.	Length	*					
3.14.0		Rails	For bridge travel			For trolley travel		



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 9 of 15

	a.	Type / section	Rails sections as per IS: 3443 Grade 50 C 12. Joint to be butt-welded by thermit welding & fusion welding or by end clamping arrangement. (Min. 60 lbs)
	b.	Standard conforming to	IS: 3443
	c.	Weight per metre	*
	d.	Material	Rail Steel
	e.	Top width in mm	*
	f.	Height in mm	*
3.15.0		Type of platform required on the bridge	Chequered plate platform 6mm thick as per IS : 3502
	a.	Position of access point	From cabin
	b.	Emergency escape	Rung Ladder at ends
	c.	Type of access platform to cabin	By Rung Ladder
	d.	Length	Full span length
	e.	Provided on both side	Yes
	f.	Width of platform	*On panel side: During detailed Engineering *On drive end side: During detailed Engineering (Min. 750mm clear space from electrical panels / equipments from the trolley on panel side and Min. 750 mm on drive end side from the trolley on drive end side)
3.16.0		Type of operators cabin	
	a.	Type of construction	Open/Closed type , Fixed to the box girder. Window type with one exhaust fan and one supply fan for ventilation
	b.	Size in mm	2500/1800 mm with a head room of 2000 mm
	c.	Illumination	40W florescent tube + Bulk head fitting with 60W incandescent lamp – 1 each
	d.	Whether warning Gong provided	Foot operated Brass gong suspended outside the cabin and operated from inside. Suitable for 240 V AC of noise level 95 dBA at 3.5 m
	e.	Fans provided	Ventilation supply fan + Exhaust fan – 1 each – size 10"
	f.	Type of fire extinguishers	1 no. 4.5 kgs CO2 type
	g.	Seating arrangement	Swivelling type chair
	h.	Position of controllers	In front / side of operator's chair
3.17.0		End carriage span (wheel base)	As per IS 807 (latest edition)
3.18.0		Motors	



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 10 of 15

3.18.1		Hoist Motions	MH	AH	Telescopic hoist
	a.	Type	SC, suitable for Inverter duty	SC, suitable for Inverter duty	SC, suitable for Inverter duty
	b.	Enclosure	TEFC	TEFC	TEFC
	c.	Numbers furnished	One per motion		
	d.	Voltage, phase and frequency	400 V+/- 10%, 3 phase, 50 Hz +/- 5% AC Combined voltage & frequency variation = 10% absolute		
	e.	Class of protection	IP – 54		
	f.	Rated capacity (KW)	Selected motor rating should have minimum margin of 15% over maximum continuous load demand including voltage and frequency variation, temperature rise and other factor. Motor nameplate rating at 50 °C shall have at least 15% margin over the input power requirement of driven equipment at rated duty point.		
	g.	Duration factor/duty	40 % CDF / S-5		
	h.	Speed (rpm)	*		
	i.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B		
	j.	Number of starts/ hour	150 starts / hr		
	k.	Contactors for motor	*		
	l.	Overload protection for motors provided	Overload reply to be provided.		
	m.	Space heater requirements	For motors of rating 30 KW and above		
3.18.2		Travel Motions	CT	LT	Telescopic hoist
	a.	Type	SC, suitable for Inverter duty	SC, suitable for Inverter duty	SC, suitable for Inverter duty
	b.	Enclosure	TEFC	TEFC	TEFC



**TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES**

MARIB GTPS

**DATA SHEET A/B
(WITH VVVF DRIVES)**

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 11 of 15

	c.	Numbers furnished	One no.	Two nos.	one motor for CT motion of telescopic hoist
	d.	Voltage, phase and frequency	400 V+/- 10%, 3 phase, 50 Hz +/- 5% AC Combined voltage & frequency variation = 10% absolute		
	e.	Class of protection	IP – 54		
	f.	Rated capacity (KW)	Selected motor rating should have minimum margin of 15% over maximum continuous load demand including voltage and frequency variation, temperature rise and other factor. Motor nameplate rating at 50 °C shall have at least 15% margin over the input power requirement of driven equipment at rated duty point.		
	g.	Duration factor/duty	40 % CDF / S-4		
	h.	Speed (rpm)	*		
	i.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B		
	j.	Number of starts/ hour	150 starts / hr		
	k.	Contactors for motor	*		
	l.	Overload protection for motors provided	Yes		
3.18.3		Space heater requirement	For motors of rating 30 KW and above		
3.19.0		Limit switches	Main hoist	Aux. hoist	Cross Travel
	a.	Type	Rotary gear + Gravity		Lever type
	b.	Number provided	1 + 1	1 + 1	2
	c.	Rating of contacts	*		
	d.	Material of contacts	Double break Silver Cadmium		
	e.	Control voltage	110V		
3.20.0		Power conductors (DSL)			
	a.	Type	LT: PVC shrouded conductor bus bar. CT: Flexible trailing cable mounting on retracting support (Festoon type) ERP insulated Cu conductor as per IS: 9968		
	b.	Size	*		
	c.	Material	Copper		



**TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES**

MARIB GTPS

**DATA SHEET A/B
(WITH VVVF DRIVES)**

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 12 of 15

	d.	Numbers	4 Nos			
	e.	Length	Suitable for bay length			
3.21.0		Protective Panel				
	a.	Make	OEM			
	b.	Size	*			
	c.	Material	2 mm thick cold rolled steel or 3mm thick hot rolled steel sheet.			
	d.	Numbers and location	One number located in cabin			
3.22.0		Control panel				
	a.	Make	OEM			
	b.	Size	*			
	c.	Material	Rolled sheet steel 2mm size			
	d.	Numbers and location	One each for MH, AH, CT and LT located on bridge platform			
	e.	Degree of protection	IP 52			
3.23.0		Master Controllers	Main Hoist	Aux Hoist	Cross Travel	Long Travel
	a.	Number of steps	5	5	4	4
	b.	Voltage & current rating	10 A, 400 V			
	c.	Type	Heavy duty type having DOP IP54			
	d.	Location	In cabin			
3.24.0		Control for Hoists /CT/LT operations	Through Variable Voltage Variable frequency drive			
	a.	Speed control	Thru' VVVF with minimum 6 pulse design			
	b.	Starting torque of VVVF	Up to 400 % typical with / without encoder			
	c.	Starting current	Less than 150 % of rated torque.			
	d.	Temperature	VVVF system shall be capable of withstanding upto 50 ° C without derating.			
3.25.0		Additional Operation	Through Radio remote control			
	a.	Type	Microprocessor based digital technology			
	b.	Communication	Should communicate up to 100 m approx.			
	c.	Operation	Main controls thru' single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch or push control type.			



**TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES**

MARIB GTPS

**DATA SHEET A/B
(WITH VVVF DRIVES)**

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 13 of 15

	d.	Local unit	One local unit (receiver side) with selector switch for operation either from cabin or radio remote unit.	
3.26.0		Cable	Power	Control
	a.	Material	Copper	Copper
	b.	Type	FRLS PVC	
	c.	Size	Min 2.5 mm ² for copper	Min 2.5 mm ² (Stranded minimum – 7 strands)
	d.	insulation	XLPE	
	e.	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage.	
	f.	Inner sheath	Extruded PVC conforming to ST-2	Extruded PVC conforming to ST-2
	g.	Outer sheath	FRLS-PVC	FRLS-PVC
	h.	Armour	Galvanised steel for multicore	Armour
	i.	Voltage grade	1100 V	
3.27.0		Earthing		
	a.	Material of earthing	Copper	
	b.	Earthing as per specification	Yes	
3.28.0	a.	Contactors	AC 4 duty for reversing application. AC 3 duty for non reversing application	
	b.	Switches	AC 23 for motor application, AC 22 for other application.	
	c.	Fuses	HRC	
	d.	Overload relay	Temperature compensated bi metallic with single phasing preventor.	
3.29.0		Power supply	One(1)/Two (2) nos. 400 V , 3 phase, 4 wire supply at operating floor at centre of bay length with change over switch.	
3.30.0		Transformer		
	a.	Quantity	2 X 100 % for Control and 1 no for Lighting	
	b.	Voltage Rating	Control 400/110V, Lighting 400/0-24-240V	
	c.	KVA rating	20% over loading to be considered while sizing the rating	
3.31.0		Illumination		
	a.	In cabin	40W florescent tube + Bulk head fitting with 60W incandescent lamp – 1 each 2 nos. 24V - 5A - 3 pin industrial socket	
	b.	Over Bridge	4 nos 60 W Bulk-head fittings with incandescent lamps and 4nos. 24V - 5A - 3 pin industrial socket	
	c.	Under bridge	4 nos 250 W HPSV lamps	
	d	For inspection of crane components	One (1) portable 40 W hand lamp with min. half span length flexible cable for inspection of crane components	



**TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)**

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 14 of 15

3.32.0		Fire Extinguisher	
	a.	Type and size	4.5 kg CO ₂ type
	b.	Location	One in cabin and Three on bridge
3.33.0		Ventilation	One (1) no. electric fan in cabin.
3.36.0		Electric wire rope hoists	<u>Telescopic hoist with</u>
3.37		Overload alarm	<u>Overload alarm to be provided for crane</u>

Note : Other requirements for the system.

- Monorail beam for telescopic hoist of 10T Cap. Is in vendor scope.
- The crane shall be fitted with gangways on the crane bridges or with gangways fitted to the sides of the crane.
- The end-carriages of all cranes shall generally be of welded box-girder construction. Buffers shall be provided at the faces on the end carriages. The end-carriages shall also be fitted with wheel-breakage supports designed to prevent derailment.
- The deflection of the crane bridges at nominal load shall not exceed 1/1000 of the span .
- The crabs shall be covered with smooth sheet metal and fitted with handrails.
- The crane and crab running wheels shall be made of cast or forged steel and shall have double flanges. The wheels should have rolling bearings lubricated for life. The running wheels shall be fitted with removable covers.
- All pendant control panels shall be fitted with rocker-type or push button switches for the crane functions. A key switch and an emergency stop switch shall also be provided on each panel. Additional switches or pushbuttons shall be provided as required.
- The emergency stop switch is to be designed in the form of a mushroom shaped switch which, when struck by hand, disconnects the entire supply to the crane.
- The main power supplies to the overhead cranes shall be in the form of 4 pole in tubular tracks trailing cable.
- The crab power supplies and the power supplies to the control panels shall also be in the form of trailing cables (festoon type) with cable carriers running in tubular tracks.
- The maximum tension in this rope must not exceed 1/8 of the calculated breaking capacity of the rope. The ropes must be of the stranded type, and galvanized wires must be used and the rope shall have a hemp core.
- The eyes of the single ropes must be secured with compression fittings. The length of the eyes must be at least 15 times the nominal diameter of the rope.
- factory and acceptance certificates must be submitted for all ropes and materials.



TECHNICAL SPECIFICATION
FOR 60T DOUBLE GIRDER EOT CRANES
MARIB GTPS
DATA SHEET A/B
(WITH VVVF DRIVES)

SPECIFICATION NO. PE-TS-372-501-A-001

VOLUME II - B

SECTION -D

REV. 00

DATE: 04.02.2013

Page 15 of 15

14. The crane and crab drive shall be in the form of a central drive or two-corner drive as in data sheet. Transmission shafts shall be supported by rolling bearings at several points and shall have drive splines at the ends.
15. The lifting gear shall be equipped with flexible couplings, totally enclosed oil-lubricated gear units. Double-shoe brakes, electro-hydraulic and electro-magnetic brake lifters and limit switches. The electro hydraulic brake units of the travel drives shall be fitted with adjustable lowering valves.

IF IN DOUBT ASK

DETAIL 'Y'

DETAIL 'Z'

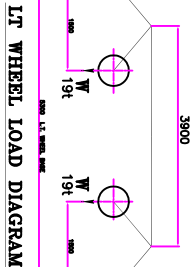
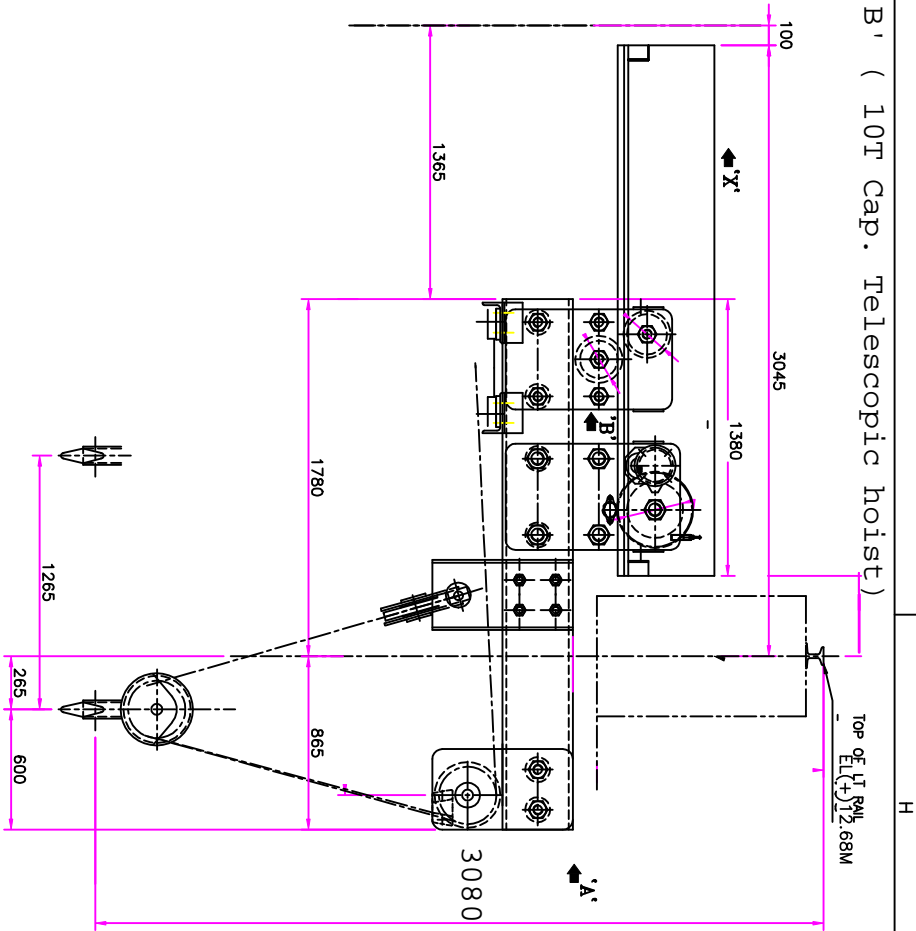
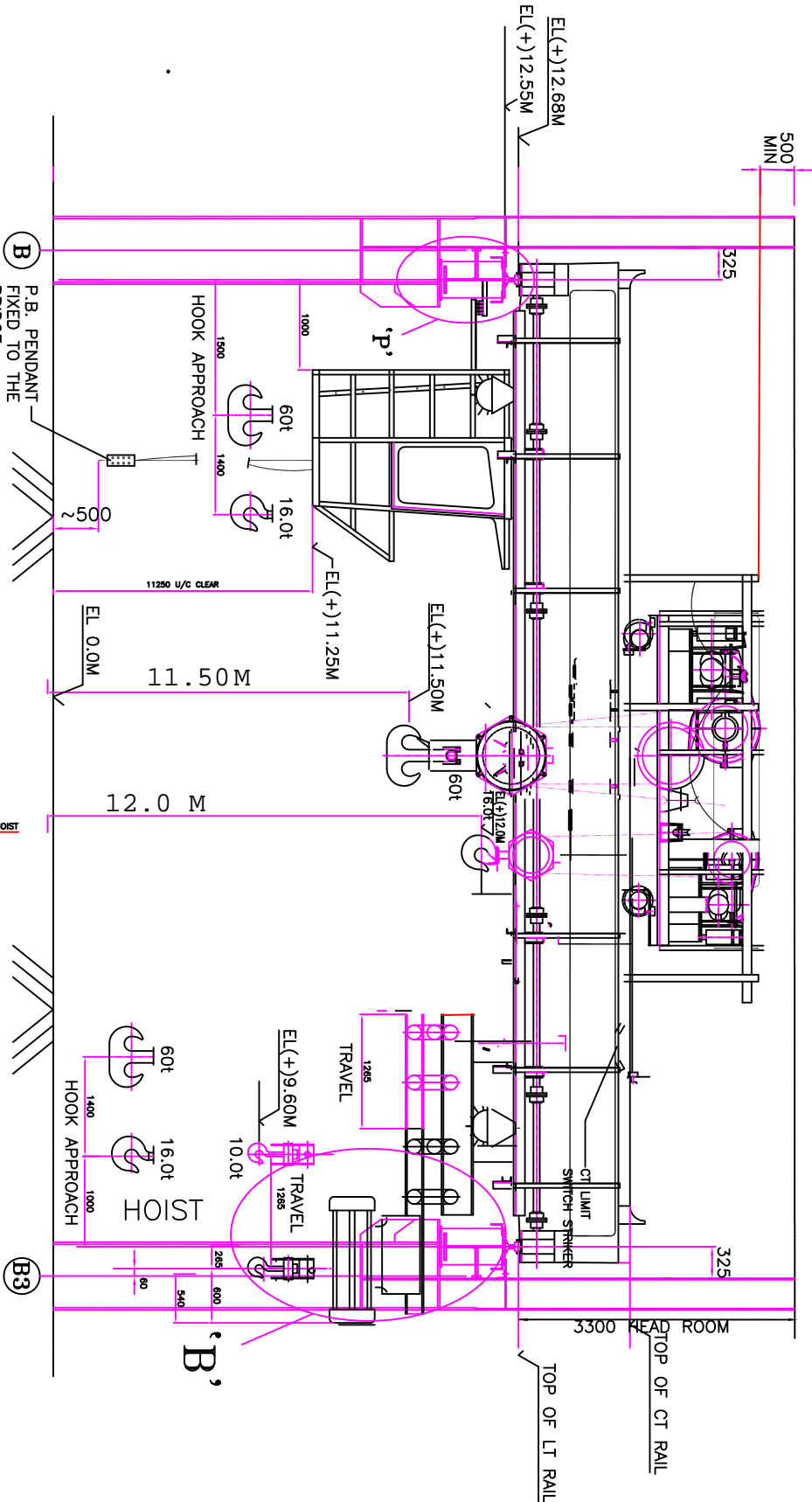
LOF HOOK

LOF HOOK

KEY PLAN

KEY PLAN

Detail 'B' (10T Cap. Telescopic hoist)



NOTES
1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.



PUBLIC ELECTRICITY CORPORATION(PEC)
MINISTRY OF ELECTRICITY AND ENERGY
SANA'A, REPUBLIC OF YEMEN

400MW MARIB GAS TURBINE POWER STATION

(PHASE-II)



THE KUJJAN CORPORATION
ENGINEERS ARCHITECTS CONSULTANTS
PHILADELPHIA, PA, U.S.A.

CUSTOMER DOC. NO.

NAME

SIGN

DATE



BHARAT HEAVY ELECTRICALS LTD.
RANIPUR - HARDWAR

DRN

AK

CHD

RN

APD

GBC

SCALE

WEIGHT(KG)

REF TO ASSY DRG.

CODE

TITLE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

CRANE CLEARANCE DIAGRAM CARD

CODE

Technical Specification for VVVF Control drive



TITLE

TECHNICAL SPECIFICATION**VVVF DRIVE****400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

DATE 03.02.13

Rev 00

SHEET

1

OF 5

1.0 General

- a) This part of the specification describes the general requirements for the Variable Voltage Variable frequency Drives, herein referred to as AC Drives, for use with standard IEC design AC squirrel cage induction motors. The nominal values, the standard documents and the drive's minimum performance are defined in this part. **To avoid any mismatch between the motor and its control equipment, the AC Drive shall be capable of auto adjustment by automatic measurement of the motor parameters with/without motor rotation.**

- b) Inverter construction and related devices :

Construction shall be divided in 3 broad sections. Section One converts AC Supply into DC supply. Section 2 Converts and controls DC supply into AC Supply with regulation. Section 3 shall be used for braking action of the motor and Dynamic Braking Unit (DBU) can be inbuilt or external depending upon the drive capacity. VVVF can be used in open loop (without external speed feed back) like in Travel motions or close loop (With external speed feed back) like in Hoist motions. Chokes on input supply side are generally used in crane application for power regulation. Like all other electronic / electric devices VVVF drives are also protected by MCB / MCCB / Fuses. VVVF drives are sensitive to temperature and hence drive internal as well as external cooling fans are provided.

- c) Programming of VVVF Drives.

VVVF drives shall be programmable and for that purpose detachable digital Operator display unit shall be supplied along with the VVVF having required buttons for setting the user constant, functions etc. The VVVF drive is to be fine tuned by matching the motor parameters and setting the parameters on full load.

- d) VVVF drives shall be connected with power supply and these drives generate their own low voltage control supply. Potential free contacts shall be connected to this control supply and few programmable control terminals. Starting / stopping / set speeds operations of VVVF drive shall be achieved by above control connection.
- e) VVVF shall give smooth control over acceleration and deceleration making the motion jerk free and using Variable voltage variable frequency limits the inrush current to the squirrel cage motors. VVVF provides controlled torque to the motor due to which crane operations are jerk free.

1.1 Experience

The Frequency Converter Manufacturer shall have adequate experience in frequency converter manufacturing and have adequate business volume in order to provide credibility in his commitments and a capability of long term support.



TITLE

TECHNICAL SPECIFICATION**VVVF DRIVE****400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

DATE 03.02.13

Rev 00

SHEET

2

OF 5

1.2 Local support

The Supplier shall have a permanent representative office with a trained and skilled support staff, in the country where the goods are delivered, in order to prove his commitment for local support and to provide a channel for communication.

The engineers employed by the Supplier's regional office shall be certified by the Manufacturer and provide start-up service including physical inspection of the drive, connected wiring and final adjustments, to ensure that the AC Drive meets the required performance.

The Supplier shall be able to give basic drives training to the Customer's engineers, preferably on the site. The training shall, as a minimum, include system concepts and basic troubleshooting.

2.0 Basic requirements for the AC Drives**2.1 General requirements**

The AC Drive shall comply with National(country of origin) and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, VDE).

The AC Drive shall be of the most modern design, yet user friendly and be simple to install, commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be : CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives, UL/CSA marked according to UL 508C.

The AC Drives have to be built to comply with the IEC standards.

The AC Drive shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux vector control open loop(for travel) and closed loop(for hoist). It shall have diodes / thyristors in rectifier and IGBT's in the inverter section in their entire power range, and it shall have the following minimum specifications.

Rated Input Voltages	380V -15% 480V +10%, three-phase
Rated Input Frequency	50Hz +/- 5%
Output Voltage	0 – Input voltage, three-phase
Output Frequency Range	0 to 400 Hz
Acceleration / Deceleration Time	0.01 – 999s, adjustable, linear, with S, with U or customised shapes



TITLE

TECHNICAL SPECIFICATION**VVVF DRIVE****400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

DATE 03.02.13

Rev 00

SHEET 3 OF 5

Overload capability (Constant Torque)	150% of nominal current for 1min.
Operating ambient Temperature	-10°C up to 50°C (shall be derated suitably if not rated at 50°C)
Storage ambient Temperature	-25°C up to 70 °C
Maximum operating altitude	1000 m without de-rating, 1000...3000 (shall be de-rated suitably)
Max. Relative Humidity	95 %, without condensation and dripping water.
Main Protections	Over current, short circuit between phase, short circuit between phase and ground, input phase loss, output phase loss, motor overload, over speed, over voltage, under voltage, drive over temperature

The AC Drive shall be able to give a 100 % output current continuously in the above specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the Manufacturer shall inform the required derating, if the ambient temperature given in the project-specific specification is higher than rated ambient of the drive or if the installation altitude is more than 1000 m above the sea level. The de-rating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the reliability of the AC Drive shall suffer.

Suitable encoder shall be provided for main hoist motion.

3.0 User interface

3.1 General

The user interface shall be identical throughout the power range and type to avoid confusion amongst the users and need for training in several different units.

3.2 Inputs and outputs

- A. At least, the following standard Inputs and Outputs shall be provided, to be used in interface with the control system:

Analogue Inputs	:	1 x Programmable differential voltage input $\pm 10V$, 1 x Programmable current input 0(4) - 20mA 1 x Programmable voltage input 0 – 10V
Analogue Output	:	1 x Programmable analogue outputs 0(4) - 20mA or 0 – 10V
Logic inputs	:	6 x Programmable logic Inputs isolated from the mains



TITLE

TECHNICAL SPECIFICATION**VVVF DRIVE****400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

DATE 03.02.13

Rev 00

SHEET 4 OF 5

Relay Outputs : 2 x Programmable Digital outputs with a changeover dry contact

All the control terminals shall be clearly marked.

B. At least, it shall be possible to assigned the following functions to the I/Os:

Analogue input	Analogue outputs
Speed reference Summing reference	Motor current Motor frequency Motor torque Motor power
Logic input	Relay or logic outputs (open collector)
Forward Reverse Jog Preset speeds Reference switching Ramp switching Parameter sets selection Fast stop Freewheel stop + speed - speed External fault	Ready Drive running High speed attained Drive fault Frequency threshold attained Motor thermal state attained Torque or current limitation attained Brake control

3.4 Programming terminal

- A. The AC drive shall have a keypad /display for programming and controlling purposes. An IP54 or IP65 remote mounting shall be possible at a distance of 10m.
- B. Password protection shall be provided to avoid unauthorized tampering with the set parameters.
- C. The programming terminal shall be able to display the commercial reference of the AC drive and of the options, the software version, the serial number
- D. Direct keypad entry shall be provided to observe the following actual parameters. Any one of the following parameters or actual values shall be selected to be always displayed :-
 - i) Input Voltage
 - ii) Input Frequency
 - iii) Output Frequency
 - iv) Output Power



TITLE

TECHNICAL SPECIFICATION**VVVF DRIVE****400 MW MARIB GTPS**

SPECIFICATION NO. PE-TS-372-501-A001

VOLUME II - B

SECTION -C

DATE 03.02.13

Rev 00

SHEET

5

OF 5

- v) Output Current
- vi) Motor Speed

The following parameters shall always be displayed during normal operation :-

- i) Drive Status

The following drive control functions at least shall be available from the keypad :-

- i) Run
- ii) Stop
- iii) Local / Remote selection.
- iv) Forward/Reverse (if function enabled)
- v) Accelerate
- vi) Decelerate
- vii) Parameter setting

3.5 Application programming

The AC Drive shall be designed for both simple and the most complicated applications, yet it shall be user friendly. It shall be possible to reset the parameter settings back to the original factory settings through the keypad.

3.6 PC Tools

The AC Drive Supplier shall have a Windows based PC software available for monitoring and controlling the AC Drives, and the software shall be offered as an option. The software shall be supplied with the necessary hardware and a provision for connecting a PC with the AC Drives. It shall be possible to set and modify parameters, control the drive, read actual values and make trend analysis using the software.

4.0 Software features

A. Restart

In the event of a fault trip due to over voltage, over current or loss of analogue signal, the AC DRIVE shall be programmable to attempt an automatic restart. For safety reasons, the maximum number of attempts shall be within a selectable time. If the fault does not clear after the attempts, the drive shall lock out.

B. Brake logic control

The AC Drive shall have a built-in function to control a mechanical brake in order to move the load in a smooth and safe way. The brake logic control shall be adapted to the different movements : hoisting, travel, orientation.

5.0 Preferred makes:

Schneider Electric, L&T-YASKAWA, Siemens, ABB, Allen Bradley (Rockwell Automation).

Technical Specification for EOT Crane



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 1 of 23

DOUBLE GIRDER EOT CRANE

1.0.0 SCOPE

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for EOT cranes and shall be applicable unless the requirements are addressed otherwise in BHEL / BHEL's Customer approved documents.

2.0.0 CODES AND STANDARDS

The equipment to be supplied under this specification shall conform to the following codes and standards (latest revisions) unless otherwise specified hereinafter.

- | | | |
|-------|-----------------|---|
| i) | IS 807: 1976 | Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists |
| ii) | IS: 3177 (1999) | Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes. |
| iii) | IS: 2266 | Specification for steel wire ropes for general Engineering purposes. |
| iv) | IS: 4029 | Guide for testing induction motor (for temperature rise). |
| v) | IS: 15560 | Steel hooks for standard shank design. |
| vi) | IS: 3443 | Specification for crane rail section. |
| vii) | IS: 325 | Three phase induction motors. |
| viii) | IS: 900 | Code of practice for installation and maintenance of induction motors. |



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 2 of 23

ix)	IS: 4237	General requirement of switchgear and Control gear for voltage not exceeding 1000 V.
x)	IS: 434 (Part I)	Copper conductors rubber insulated cables for voltage up to 1000V.
xi)	IS 1596	Polyethylene insulated PVC sheathed cables
xii)	IS 3043	Code of practice Earthing
xiii)	IS: 3938	Electric Wire Rope Hoists.
xiv)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
xv)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
xvi)	IS: 691	Flexible trailing cables rubber insulated.
xvii)	IS: 1653	Steel conduits for general engineering purposes.
xviii)	IS: 2509	Rigid non-metallic conduit for electric - Installations
xix)	IS: 2062	Steel for General Engineering purposes.
xx)	IS: 1030	Carbon Steel castings for general engineering purposes.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 3 of 23

xxi)	IS: 1570	Schedules for Wrought steels.
xxii)	IS: 1875	Carbon steel billets, blooms, slabs and bars for forgings.
xxiii)	IS: 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
xxiv)	IS: 1852	Rolling and cutting tolerances for Hot rolled steel products.
xxv)	IS: 2291	Tangential Keys and Keyways.
xxvi)	IS: 2292	Taper Keys and Keyways.
xxvii)	IS: 3961	Recommended current rating for cables.
xxviii)	IS: 694	PVC insulated cables for working voltages up to and including 1100V)
xxix)	IS: 1554 (part-I)	PVC insulated (heavy duty) electric cables: Part 1: for working voltages up to and including 1100 volts.
xxx)	IS: 4289	Flexible cables for lifts and other flexible connections: Part 1: Elastomer insulated cables.
xxxi)	BS: 970	Wrought steels in the form of blooms, billets, bars and forgings.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 4 of 23

xxxii) IS: 5749/ BS 3017 Specification for Forged Rams horn Hooks

xxxiii) IS:3938 Specification for electric hoist.

Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, the more stringent of the two as per interpretation of purchaser shall govern.

3.0.0 DOUBLE GIRDER EOT CRANE

3.1.0 DESIGN REQUIREMENTS

3.1.1 The crane shall be designed in accordance with the latest edition of IS-3177 , IS-807 and any other standard as referred there in and subject to any modification and requirement as specified herein after.

Class of crane mechanism shall correspond to that of the crane requirement and as specified elsewhere.

3.1.2 LT storm/parking brakes shall be also be considered in addition to service brakes. The design wind speed and other factors for brake selection shall considered in line with details given elsewhere in the specification.

3.1.3 Safety devices should be provided with all equipment/parts covered under this specification.

3.1.4 Parts requiring replacement or lubrication shall easily be accessible without dismantling the other equipment or structures. All electrical cables shall be laid to comply with recognized standards and purchaser's requirements.

3.1.5 For welded construction such as bridge girders, end carriages, rope drum, gearboxes etc. steel shall be conforming to IS-2062 quality. Welding shall be carried out only by qualified welders and subjected to NDT as specified in Quality Plan.

Welding shall be carried out by welders qualified as per ASME Boiler and Pressure vessel code Sec. IX. Radiographs shall be inspected to a sensitivity of 2%.

a. Welding shall be performed by shielded electric arc, gas or other approved methods. The electrodes used for welding shall conform to AWS A5.1.

b. Wherever lateral welding of the main plates of box girders are required, it shall be butt-welded.

c. Qualification of welding procedure and welder: These shall be carried out as per ASME Boiler and Pressure vessel code Sec. IX - Welding and brazing qualifications.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 5 of 23

- d. Electrode designations and qualifications shall be as per AWS A 5.1.
- e. Electrodes should be of radiography quality with heavy covering as per IS: 814 and relevant requirement of ASME Sec IX and IIC.
- f. Bare electrodes as per IS: 7280 and flux wire combination as per IS: 3613.

3.1.6 No cast iron part shall be used on the crane.

3.1.7 Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads.

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

Suitable guards shall be provided to revolving shafts, coupling etc.

3.1.8 All cables shall be clamped individually. All trailing cables shall be clamped with PVC or non-metallic clamp.

3.1.9 Walkways of CT shall be of chequered plate minimum 6 mm thick O/P at least 800 mm clear inside with non-skid toe plates 8mm thick, projecting 100 mm above the floor. Walkways shall be of rigid construction and designed to sustain a distributed load of not less than 300 kg/ sq. mm.

Intermediate posts for supporting handrails shall not be spaced more than 1.5 meters apart.

Ladders provided shall have at least 450mm clear width with 20 mm rungs (rods) spaced 300 mm apart.

3.1.10 All wheels, couplings, open gear etc. shall be provided with covers.

3.1.11 All bolts except those with locknut shall be provided with grip lock nuts or spring washers.

3.1.12 Fasteners for pedestal blocks, motors, gearboxes etc. shall be easily removable from the top. Studs shall not be used as fasteners for mechanical items except for fixing covers.

3.1.13 Defects in the material like fractures, cracks, blowholes, pitting etc. are not allowed. Rectification of any such flaw is permissible only with the approval of the purchaser.

3.1.14 All parts of the crane shall be thoroughly cleaned of mill scales, rust or foreign matter and then painted as per the specification requirements.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 6 of 23

The permissible camber shall be shown in drawing or data sheet submitted for approval.

Permissible variations in speeds at full notch with rated load, voltage and frequency shall be as follows:

- Traveling and traversing: $\pm 10\%$
- Hoisting: $\pm 10\%$
- Lowering: $\pm 10\%$

3.2.0 **STRUCTURAL DETAILS**

3.2.1.0 Crane structure shall be designed in accordance with the latest edition of IS-807 after taking the following additions/deviations as applicable.

3.2.1.1 Black bolts shall not be used in the main structure of the crane. The calculated strength of other bolted joints in structural members shall not be less than net strength of member plus 25%.

3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member.

3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.

3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367

High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623

3.2.1.5 Transverse filled welding on load carrying member shall be avoided.

3.2.1.6 All butt welds on structural members subjected to tensile stress shall be of radiographic quality as ASME Sec VIII Div.1 acceptance norms.

3.2.1.7 Fillet welding on load carrying members shall be avoided.

3.2.1.8 For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm.

3.2.1.9 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 7 of 23

- 3.2.1.10 Minimum thickness of chequered plates for platform shall be over 6 mm over plain. Chequered plates shall not be considered for strength calculations of load carrying members.
- 3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof.
- 3.2.1.12 However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splice in line with the gravity axis of the member joined so as to avoid the eccentricity of the loading.
- 3.2.1.13 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.
- 3.2.1.14 Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending. For splicing tension members, the net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axes of the splices are in line with the gravity axis of the member to avoid eccentricity.
- 3.2.2 Bridge Girder**
- 3.2.2.1 The bridge girder shall consist of a box construction with double Web plate girders or lattice girders and shall be of adequate strength to withstand the rolling loads and other stresses it is subjected to.. The design of the girder shall be in accordance with latest edition of IS- 807.
- 3.2.2.2 Maximum deflection of the bridge girder, with safe working load, shall not exceed 1/900 of the span or as per latest IS. The girder shall be supported on the centerline of LT wheels during the deflection check. The girder shall be cambered by an amount by an amount equal to the maximum deflection.
- 3.2.2.3 Box section shall be adequately reinforced by internal diaphragms and ribs to withstand the most severe combination of load that may develop under different



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 8 of 23

working conditions. Additional Internal diaphragms shall be provided at points where external members are welded for providing support to drives etc.

3.2.2.4 Box girders shall be provided with end plates sealing. Diaphragms inside the girder shall extend to the full - width & depth of the girder and the web plates shall be reinforced by angles all along the full length of the plates spaced midway between the diaphragms. Full depth diaphragms or stiffeners shall be furnished at bridge drive supports and below the line shaft bearings.

3.2.2.5 Short diaphragms shall be furnished and are required to transmit the trolley wheel loads to the web plates. Trolley rail section shall not be considered into design of bridge girders.

3.2.2.6 Full length chequered platforms on both side shall be provided on the side of bridge girders as specified in data sheet - A.

3.2.2.7 For cabin operated crane, the access to operator's cabin or DSL maintenance cradle shall be from bridge platform. There should not be accumulation of water/oil inside the box girders. If required breathing holes can be provided for expansion / contraction, due to change in temperature. Tapped (threaded) holes shall be provided with ½" NPT plug in the bottom of the girders, at both ends, to drain off any accumulation of water / Oil inside the girder. Instruction shall be painted on the girders to remove the plug and check for water/oil before lifting. Plug shall be replaced after installation.

3.2.2.8 All connection splices shall be designed for full strength of member of loads indicated unless otherwise approved. Beams and connections shall be designed for 60% of shear capacity of beam section plus additional axial load if any. Not more than one splice shall be provided to make up full length of member.

3.2.2.9 Maximum Span/ Depth ratio for Girder

- Plate Girder : 18
- Lattice Girder: 12

3.2.3 End carriage

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions including collision with other cranes or stops. The length of the end



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 9 of 23

carriages shall be such that no other part of the crane is damaged in collision. End carriage shall be so designed as to distribute the load evenly between the wheels from each bridge girders.

3.2.3.2 The wheel base shall not be less than 1/5th of the span. End carriage shall be fitted with safety stop to prevent the end carriage falling more than 25 mm in the event of breakage of a track wheel, bogies or axle.

3.2.3.3 Suitable jacking pads at a suitable height from rail level shall be provided on each crane for crane jacking. Jacking pad dimensions shall be suitable for full seating of the jacking pad seat without any instability. When changing the track wheel, jacking pads shall not interfere with replacement of track wheel.

3.2.4 Crab (Trolley)

3.2.4.1 The crab frame shall be built from heavy steel section, welded properly to form single piece frame & to resist vertical, lateral and torsional strain and to support all loads without undue deflection. It should be properly machined to receive hoisting mechanism, cross traverse arrangement/mechanism, wheels etc. etc.

3.2.4.2 Sheaves, part of hoisting mechanism, shall be so arranged on trolley that rope reeling arrangement shall ensure lifting of load in vertical line with minimum of swing or side movement. Trolley shall be provided with chequered plates all over except for opening required for ropes and equipment foundation. Equipment foundation shall not be welded/ supported on chequered plates. Toe plates 100 mm high and 6mm thick shall be provided around opening provided for movement of ropes. Suitable railing shall also be provided around the opening for rope in case the opening is large.

3.2.4.3 Platforms and Ladders

a) Safe means of access shall be provided to the operator's cab and to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided as necessary..

b) Every platform shall be provided with steel chequered plate top and be securely fenced with 1050 mm high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 10 of 23

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1161 having top and bottom rail at height of 1050 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6 mm thick) shall be provided on bridge walkways and on end carriages, staircases, landing in cabin, trolley and at any other place where access is provided. Bends shall be neat and made by machine. The top rail should be so laid that there is no intermediate obstruction and hand need not be lifted from rail while walking

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

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

3.2.4.4 Operator's Cabin

3.2.5.1 Cabin shall have ample size and with clear headroom of 2m for accommodating controllers, main isolating switch and other accessories for the operation of the crane. All electrical equipment in crane cabin shall be suitably enclosed for the safety of the operator.

3.2.5.2 Cabin's platform shall be covered with an electric insulating carpet of 5mm thick.

3.2.5.3 An electric warning horn shall be provided and mounted on underside of the cabin. Control shall be arranged in such a way that the horn operates automatically when bridge travel motor is energised. In addition, manual control shall be provided on operator's cabin at a location ergonomically suitable to the operator.

3.2.5.4 Manual control shall not override automatic control and shall serve only to operate horn when the bridge is not in motion. Manual control shall be of the manual hold down type with automatic return to the open position. Horn shall be of heavy-duty howler type & adequate rating.

A foot operated electric warning horn of double bell suitable type suitable for 240 VAC of noise level 95dBA at 3.5m

3.2.5.5 One number portable fire extinguisher of 4.5 Kg capacity or as specified elsewhere in the specification shall be provided inside the cabin.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 11 of 23

- 3.2.5.6 A swing-way operator's chair.
- 3.2.5.7 Adequate illumination as per date Sheet A or as specified else where in the spec.
- 3.2.5.8 A non-oscillating ventilating fan with 380 mm sweep with complete guard and regulator.
- 3.2.5.9 Brief description of crane operation, Maintenance and periodical lubrication etc. typed in English and in local language neatly framed in a permanent frame for easy reference.
- 3.2.5.10 Area of the cabin shall be 2500x1850 (min.), with headroom as 2000 mm clear.
- 3.2.5.11 A distinct type alarm with conspicuous warning light on either side of the crane bridge to indicate overloading of the crane.
- 3.2.5.12 Suitable inspection cages to accommodate two persons to facilitate inspection of DSL.

3.3.0 **MECHANICAL**

3.3.1 **Rope drums**

Rope drums shall be of mild steel plate fabricated or of cast steel as the case may be. All fabricated rope drums shall be stress relieved. The drum shall be so designed to take full length of hoisting rope in single layers. The end of the rope shall be anchored to the drum in such a way that the charger is readily accessible. Each rope shall have not less than two (2) full turns on the drum when the hook is at lowest position not taking into consideration the turns covered by the rope in charge. One spare groove shall be provided for each rope lead when the hook is at the highest position. Each rope end shall be clamped with minimum two clamping wedges with at least two bolts on each clamping arrangement.

The pitch diameter of the drum shall be as per IS - 3177 or as specified elsewhere. The depth of the groove shall not be less than 0.35 times the rope diameter. Each rope shall be clamped to drum with two clamp wedges with at least two numbers of bolts on each clamping arrangement.

For evaluation of Radiography the designed thickness of the drum (top of crest to ID) shall be taken into consideration and not the thickness of plate selected.

3.3.2 **Hoist ropes**

Ropes of fibre /steel core as specified in Data sheet "A" shall be of right hand lay, 6x37 or 6x36 construction of best plough steel having minimum tensile strength as



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 12 of 23

180 kg/cm². Left hand lay wire ropes shall not be used (Reverse bend ropes shall be avoided as far as possible).

3.3.3 **Rope sheaves**

Sheaves shall be of cast (Castings to IS: 1030 Gr. II with Y.P. greater than 50% of UTS) or forged steel. All sheaves shall be identical, however, exception may be made for equalizer sheave. Sheave groove shall be ground finished for getting increase rope life. Equalizer sheave shall be arranged to turn and swivel in order to maintain rope alignment under all circumstances.

3.3.4 **Wheels**

LT & CT wheels shall be double flanged with taper/ straight tread. The wheels shall be capable of taking up misalignment in span as specified. Solid wheel shall either be of forged steel or as specified in Data sheet. The wheel rim shall be with minimum hardness of BHN 300-350. Wheels may be either hardened on tread portion as per IS –3177 or Volume hardened. Contact stresses between wheels and rails should be within permissible limits.

3.3.5 **Buffer**

Each End carriage shall be provided with buffer as per data sheet 'A'. Buffers should be so located that removal is not required while changing wheels or bogies. Buffers shall have sufficient tension on energy absorption capacity to bring the unloaded crane to rest from the speed of 50% of the rated speed to zero speed. Buffer is to be fitted to each end of carriage assembly and crab so that buffer contact takes place before the bridge or trolley reaches the end of rail.

3.3.6 **LT drive**

The bridge motion shall be achieved by suitable drive arrangement as specified elsewhere. When twin drives are used, these shall be operating in unison to avoid skewing effect. The drives shall be interlocked for simultaneous starting, stopping & speed control.

3.3.7 **CT drive**

Trolley drive shall be achieved by suitable drives & power shall be transmitted to the geared wheel by means of pinions mounted on both ends of the output shaft.

3.3.8. **Gearing**



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 13 of 23

3.3.8.1 Gears in speed reducer unit for bridge drive, hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The housing shall be of sufficient design not to permit temperature in excess of 90°C for the oil bath. Spur and helical gearing shall normally be used for all motions. Worms and bevel gears shall not be used. First high-speed reduction shall be through helical gears. All gears shall be hardened and tempered and of alloy steel with machine cut teeth 1.6 Micron finish or better and lapped with some minimum applied load to remove high spots and to improve tooth contact. Cast alloy steel is acceptable only for gears in the last stage of speed reduction. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 **Gear Box**

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. In case of totally enclosed gearboxes, splash or automatic lubrication system shall be used. Covers shall be split horizontally at each shaft centre line, so that top half can be removed for inspection and repair with out disturbing the bottom half. Gear shafts shall be supported on ball/roller bearings mounted in gearbox unless specially agreed otherwise. The bear boxes shall be provided with breather, air vent, oil level indicator, dip stick, drain plug and lugs for lifting.

Radial clearance between the gear boxes inner surface and outside diameter of the gears shall be at least 1.25 times the depth of larger gear tooth inside the gear box or 20mm which ever is higher. Facial clearance between inner surface of gearbox and face of gear or pinion shall be at least 20 mm. Gearbox shall be inspected in line with QP and as per PEM (Q)/001 enclosed.

3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved at a temperature between 590 to 680 deg. C. The temperature shall be maintained within ± 20 deg. C and at no time during the soaking cycle the temperature shall fall below 590 deg. C or exceed 680 deg. C. Soaking shall be done for a period proportionate to 1 (one) hour/ 2.5 cm. of wall thickness.

3.3.10 **Bearing**



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 14 of 23

3.3.10.1 Ball and roller antifriction bearing of FAG, SKF, NBC, NORMA, make shall be used throughout, except where specified otherwise. Drive side bearing on Hoisting equipment shall be ball / roller bearing type. Rated life of ball and roller bearing shall be not less than total working life as per relevant Codes IS-3177. Life of bearing shall be calculated in accordance with manufacturers recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Lubrication arrangement and clamping shall be done neatly. Bends in pipe shall be done with the help of machine. Bearing enclosures shall be designed as far as practicable to exclude dirt and shall prevent oil leakage. Accessibility should be such that parts may be safely lubricated from the walkway or ladder when the crane is not in motion.

3.3.11. **Shafts, Couplings and axles**

3.3.11.1 Shafts and axles shall be made from solid rolled or forged steel bars and shall have ample strength and rigidity and adequate bearing surface. If shouldered, they shall be provided with fillets of ample radius and /or be tapered to avoid stress concentration.

Motor shafts shall be connected to gearbox input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts. For driving hoist drum full-gear couplings shall be used between hoists drum & hoist gearbox output shaft. Couplings shall be of cast steel/wrought steel conforming to IS: 210 grade 260 and shall be designed to suit service conditions.

3.3.11.2 Self-aligning type gear couplings shall be used between connection shafts to take care of transverse connection shafts to take care of transverse as well as axial movement whenever necessary. Whenever components of considerable amount of inertia are directly mounted on the high-speed shaft (e.g. brake drum, coupling etc.) they shall be balanced statically to minimise vibration.

3.3.12 **Repair Cage**

A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. The repair cage shall be adequately sized to accommodate two persons. And guarded for safety and correctly located for the intended service. Suitable access to the cage shall be provided. Repair cage shall be provided at the corner of the crane.

3.3.13 **Lifting hook**



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 15 of 23

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition. All hooks used shall be in normalized condition only.

3.3.14 **LIFTING HOOK BLOCK ASSY**

3.3.14.1 Lifting hook block assembly shall be Ram shorn type or approved for capacity greater than 50 Tonnes and point hook with Shank for capacity below 50 Tonnes and shall be of forged steel construction. Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable. All hooks used shall be in normalized condition only. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely.

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

3.3.15 **Brakes**

3.3.15.1 Selection and design of brakes shall be such as to meet the requirement. Brakes shall be designed to suit 150% of torque transmitted to the brake drum with full load for hoist motions and 125% of motor rated torque before derating for LT/CT motion. Brakes shall be provided as specified in Data Sheet 'A'. Brake drum shall be separately mounted and coupling halves shall not be used as brake drum.

i) **SERVICE BRAKE**

Double shoe types & disc type service brakes shall be provided for each motion of the crane as specified in Data Sheet. The service brakes shall apply automatically when power supply to the drive motor is cut off or fails.

ii) **HOIST CONTROL**

Hoist motion (both main & aux) shall be provided with a self-contained sturdy braking system to control the speed of hoisting as well as lowering down to 10% rated speed. The braking system shall be reasonably uniform and effective in all loads at any position.

3.4.0 **ELECTRICAL**

3.4.1 The scope of supply shall cover all electrical equipments comprising from Main isolating switch, down shop leads, trolley conductors, current collectors etc.

3.4.1.1 Main Disconnecting/Isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end / at both the ends of bay length or in the middle as



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 16 of 23

specified in the data sheet A. Termination of incoming power supplies cable to isolating switch fuse unit and further cable from switch to down shop leads shall be included in the bidder's scope of work. The switch shall be provided with Power ON Red indication lamp.

3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipments on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 2% or specified in data sheet "A". It shall be supplied with brackets. Maintenance cradle for DSL shall be provided on crane. Sufficient allowance of min 20% for wear & tear shall be considered while sizing the conductor. The runway conductors shall be supported on brackets and insulators.

3.4.1.3 The current collectors shall be with adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.

3.4.1.4 The cable, supplying power to crane trolley shall be flexible trailing cable as per IS-9968 Part I (latest edition) and mounted on retracting supports (festoon type).

3.4.2 **DRIVE MOTORS**

3.4.2.1 Crane Motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The starting torque of motor shall not be less than 2.25 times the rated torque and pull out torque shall not be less than 275% of the rated full load torque of motor.. In case of VVVF drive system, the creep speed will be achieved through VVVF drives and the motors for Main hoists, Auxiliary hoist, CT and LT will be Squirrel cage. Hoisting drive motors shall be provided with antifriction roller / ball bearings on the drive side.

3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending upon the ambient temperature and voltage /frequency variation shall be applied to de-rate the motors. The minimum margin of 10% shall be considered over the calculated rating of the motor. The protection class of the motors shall be as IP-55. Motors shall be tested at manufacturers works in accordance with IS-325/as per



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 17 of 23

agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325-1978 or as per the motor spec.

3.4.2.3 All the motors shall be provided with lifting lugs Two earth terminals of adequate size to accept the earthing conductors shall be provided at diametrically opposite points unless specifically designed For higher speeds, motors shall be capable of with standing 2.5 times the rated speed.

3.4.2.4 Motors shall be painted in line with painting instructions specified in Painting Scheme Annexure IV attached along with the technical specification.

3.4.3 Limit switches

The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit & in order to prevent the crane hook from over hoisting and over lowering, One gravity type back up limit switch of hand reset type shall also be provided. This switch will operate in the event of failure of main limit switch. Lever operated limit switches shall be provided at both ends of longitudinal travel and cross traverse. These limit switches shall be self reset type. The limit switches shall be as per “Data Sheet A”

3.4.4 Switch

All switches shall be hand operated; air break, heavy duty, quick make and quick break type. Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Device to defeat this interlock shall be included. Safety Interlocks-Disconnect Switch-The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same can not be opened unless the switch is in OFF position. Main/ safety disconnect switch shall have provision of pad locking in OFF position

3.4.5. Contactors.

Contactors shall be suitable for heavy duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked. Arc chutes shall be provided where necessary.

Each contactor shall be provided with three positive acting ambient temp. Compensated thermal overload relay with adjustable setting to suit the motor current.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 18 of 23

The relay shall be hand reset type, suitable for current. The relays shall be replaceable from front. The main contactor shall be electrically interlocked so that it can not close unless all the motor overload relays are RESET and all controllers are in OFF position. The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

3.4.6 Push button and lamp

Push button shall be spring return type with 2 NO + 2 NC contacts, rated 10A, 240 V AC. Indicating lamps and lens shall be replaceable from front.

3.4.7 Protective Panel

- 3.4.8.1** The electrical protective panel shall be a cubicle fabricated from 2 mm thick sheet steel with lockable-hinged door. The control cabinet's door shall be interlocked with the operating handles of isolating switches of supply circuits so as to prevent opening of the door when an isolating switch is closed. A device for bypassing the interlock shall also be provided. It shall be dust and vermin proof with degree of protection as IP-52 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipments and devices mounted there on.

The following minimum equipments shall be provided.

- a) One triple pole air break type main contactor with thermal overload relay.
- b) One triple pole main line connecting/disconnecting switch.
- c) Emergency push button at convenient height for the operation for interruption of the entire power.
- d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.
- e) Contactors, timer and auxiliary contactors.
- f) Portable Lighting Transformer rated for 415/24V.
- g) Lighting Voltage Transformer with fuse 415/24V.
- h) Control transformer with fuses.
- i) Indicating lamps to indicate the live condition of all three phases.
- j) Main supply ON/OFF lamps on the door of the protective panel.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 19 of 23

- k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.
- l) Other equipments as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps. or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.
- m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.
- n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.
- o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.9 Master Controller (Desk type)

- 3.4.9.1 The speed of each drive shall be controlled by master controller or as specified in the data Sheet 'A' Master Controller for hoisting motion shall have 5 steps and for LT/CT it shall have minimum 4 steps. Master controller contacts shall be fully enclosed in dust and vermin proof enclosure.
- 3.4.9.2 The master controller is provided with spring to its "OFF" position. Master Controller in "OFF Position shall disconnect power supply to motors. Each controller shall bear suitably engraved inscription of motions in English and direction of motion by Arrow. Master controller shall be suitably located in operator's cabin as to provide maximum convenient and view to the operator. The master controller shall be provided with terminal block to facilitate external connection.

3.4.9.3 Starter Panel

Separate panels shall be provided for CT, LT & hoist motion (Main and Auxiliary), with following type of items.

- a) Contactors : AC4 duty for reversing applications
AC3 duty for non-reversing applications
- b) Switches : AC23 for motor application.
AC22 for other application
- c) Fuses : HRC



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 20 of 23

- d) Overload relays: Temperature compensated bi-metallic with single phasing preventor.

3.4.10 MOTOR CONTROL PANEL

The motor control panels shall be dust and weatherproof to IP-55 or as specified in “Data Sheet A” & shall be provided separate for each motion. The panel shall contain minimum the following components.

- a) Switch fuse unit with contacts of adequate rating for each motion.
- b) Thermal overload relay for each drive. These shall be ambient temperature compensated adjustable type.
- c) Contactors, timers and auxiliary contactors.
- d) The panel shall be provided with space heater. The space heater with thermostat shall be located at the bottom of the panel and shall have individual ON/OFF switch.
- e) Terminal blocks shall be stud or snap on type. A protective cover shall be fixed on top of terminal blocks to prevent accidental contact. A minimum of 20% spare terminals shall be provided.
- f) Air break contactors shall be provided for main supply as well as for motors. They shall confirm to category AC-4 as per IS-1322. These shall have three main contacts and 2 No. & 2 NC auxiliary contacts.
- g) The main contacts shall have the ratings as per duty requirement but auxiliary contact shall be rated for 5 amp 240V AC. The contactor drop off voltage shall be between 45-50% of rated voltage. The contactor coil shall be suitable for 240V AC supply.
- h) The auxiliary contactors shall have 4 No. + 4 NC contacts for control and interlocking purposes. The contacts shall be convertible. The contacts rating shall be suitable for 5 amps at 240 Volts AC.
- i) Adequate protection for overload and short circuit shall be provided for all the three phases of each motor.
- j) Double pole switch fuse unit for control circuit of the contractor ‘START (push button and a pilot lamp with the red lens for indicating the contactor “CLOSED” shall be furnished.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 21 of 23

3.4.11 Illumination

Crane lighting and space heating system shall be designed for 240V, 1Phase 50Hz supply and receptacle system with 24V 1Phase 50Hz supply or as specified in the Data sheet A. Suitable dry type transformers shall be furnished for this purpose, complete with isolation facility and Primary/secondary fuses.

- a) Branch Circuits for lighting and receptacles shall be individually protected by switch fuse units.
- b) 40W fluorescent fixtures / 60W bulkhead fittings with fluorescent lamp shall be used for lighting operator's cabin and bridge platform.
- c) Four (4) - 400 W / 250 W high bay Sodium vapour / Mercury vapour lamps shall be provided under the bridge as specified in the data sheet "A"
- d) All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
- e) 24V - 5A - 3 pin industrial socket outlets shall be provided. Two (2) in operator's cabin and minimum four (4) on the bridge along the walk way on both sides of full length platforms.
- f) One (1) portable 40 W hand lamp with min. half span length flexible cable for inspection of crane components.
- g) Operator's cabin shall be provided with one (1) electric fan and one (1) heavy-duty industrial siren. Siren shall be foot operated.

3.4.13 Grounding

3.4.13.1 The crane structure, motor frame and all other electrical equipments shall be grounded in accordance with the Indian Electricity Rules. The connections from Crane Bridge to 4th conductor of down shop leads shall be by means of current collector.

3.4.13.2 The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendant push button station shall be earthed separately.

3.4.13.3 The crane structures, motor frames & metal of all electrical equipment on EOT crane shall be effectively grounded as per Indian Electricity Rules. Grounding of the crane to the nearest pit shall be in manufacturers scope.

3.4.14 Red warning light 3 Nos. shall be provided at both ends of the gantry girder to indicate the aliveness of DSL.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 22 of 23

3.4.15 Wiring Systems

- a) Power wiring to any motor shall be done with 1100V grade aluminium/Cu conductor, extruded PVC insulated armoured FRLS cable of suitable sizes as specified in Data Sheet A.
- b) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.
- c) All control and auxiliary external circuit wiring shall be done with PVC insulated FRLS type 2.5mm stranded copper conductor.
- d) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.
- e) Each motor shall be wired independently. Power and control wiring shall be effectively separated.
- f) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.
- g) All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.
- h) Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.
- i) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points
- j) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

3.5.0 Radio Remote Control

- a) The equipment should have facility to control EOT crane by radio frequency based wireless remote unit. The equipment should be supplied with transmitter unit, receiver unit, encoder unit, decoder unit, interface panel, coupling system, battery unit and any other control gear if required.



TECHNICAL SPECIFICATION
FOR DOUBLE GIRDER EOT CRANES
400 MW MARIB GTPS

SPECIFICATION NO. PE-TS-372– 501-A001

VOLUME II - B

SECTION -D

REV 00

04.02.13

Page 23 of 23

- b) The equipment should be based upon the microprocessor based digital technology with almost nil hard wiring.
- c) The remote unit should communicate up to the distance of approximately 100 meters.
- d) The system has to integrate with the control system of crane, which operates at 110 V AC, Single phase.
- e) The remote unit should have transmitter which can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type.
- f) Frequency allotment of radio remote unit from Govt. of India, Deptt. of Telecommunication or any other agency shall be the responsibility of supplier.
- g) The transmitter and receiver unit should have its own frequency and address code with each system having its own security code so that one particular set becomes unique and there is no interference from any other remote unit device. A microprocessor should check all security codes. The processor should have its own watchdog circuit. The receiver FM band should be sufficiently narrow to allow only passing of desired frequency and valid command. Any error should shut down the system immediately.
- h) The remote unit should have safety key to prevent any unauthorized operation. All the crane operations should stop at once the communication break down occurs.
- i) On local unit (receiver side), the system should be provided with one selector switch so that EOT crane can be operated either from Operator cabin or radio remote unit.
- j) In case tandem operation is envisaged, a suitable selector switch shall be provided in the cabin for selection of Tandem/normal operation.
- k) The receiver unit along with I/O interface unit should be able to bear the vibrations and shocks encountered in normal usage of EOT crane.
- l) The system should have very fast response time.

Documents to be submitted along with offer including compliance cum confirmation certificate &.Specific confirmation / comments required from bidder .

Annexure-C

(Part of technical specification no. PE-TS-372-501-A001 for 400 MW Marib GTPS)

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

- 1.0 Specific confirmation / Comments from the bidder as per BHEL Format.
- 2.0 'NO DEVIATION CERTIFICATE' – Clearly mentioning that bidder has considered 'No - Deviation' from the technical specification provided by BHEL.

OR

DEVIATION Sheet, indicating clause wise technical deviation if any

- 3.0 Un-priced format, duly mentioned 'Quoted' against each Sl.no. below each column.
- 4.0 Stamped copy of Crane Clearance diagram No PE-DC-326-501-A001 Rev 01A)

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

Note 2:- Bidder to note that if the bidder does not submit the documents mentioned in Sl. No. 1.0 to 4.0 along with their offer then their offer is liable to be rejected.



TITLE:
TECHNICAL SPECIFICATION
COMPLIANCE CUM CONFIRMATION
CERTIFICATE

SPEC. NO.: PE-TS-372-501-A002
VOLUME: III
SECTION:
REV. NO. 0 DATE 04.02.13
SHEET 1 OF 1

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" in section C and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) The EQUIPMENT'S functional guarantees shall stand valid till at least eighteen (18) months from PERFORMANCE GUARANTEE test of equipment as per technical specification or commercial terms and conditions, whichever is later.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.



TITLE:
TECHNICAL SPECIFICATION
COMPLIANCE CUM CONFIRMATION
CERTIFICATE

SPEC. NO.: PE-TS-372-501-A002
VOLUME: III
SECTION:
REV. NO. 0 DATE 04.02.13
SHEET 2 OF 1


- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

	SPECIFIC CONFIRMATION / COMMENTS REQUIRED FROM BIDDER	SPECIFICATION: PE-TS-372-501-A001
	TITLE: 60T Cap. D/G EOT Crane	VOLUME-II B SECTION-C REVISION:00
	PROJECT: 400 MW Marib GTPS	DATE: 11.01.2013 No. of SHEETS: 2
S.N.	DESCRIPTION	REPLY / COMMENTS BY BIDDER
1.00	MECHANICAL	
1.01	Bidder to confirm the compliance of technical data sheet of EOT Crane for GT hall enclosed with technical specification(PE-TS-372-501-A001, Rev00) of this enquiry.	CONFIRMED
1.02	In case of any deviation, the same has been furnished in the separate Deviation schedule. Bidder to note that deviation mentioned elsewhere will not be taken cognizance of in any case. Bidder to confirm the same.	CONFIRMED
1.03	Bidder to comply to the adherence to the Manufacturing Quality plan for GT hall EOT crane (including electric hoist) & customer specification for inspection & testing attached in the the Technical Specification (PE-TS-372-501-A001 Rev. 00). .Any additional requirment of Customer during detail engineering shall also be adhered to without cost implication. Bidder to confirm.	CONFIRMED
1.04	Bidder to confirm that there is no deviation from the Crane Clearance Diagram (Doc No PE-DG-372-501-A001 Rev 00) attached with the Technical Specification. Bidder to specifically note that in no case any deviation from the Crane Clearance diagram wrt hook approaches, elevations,end approaches , lift , wheel load and other dimensions etc given by BHEL shall be accepted. Bidder to confirm the same.	CONFIRMED
1.05	Bidder to specifically note that there is specific requirement of the painting for this particular project. Bidder to confirm the compliance to the attached Painting specification (in technical specification no. PE-TS-372-501-A001) .	CONFIRMED
1.06	Bidder to confirm that there is no deviation from the makes of various sub vendors items as given in annexure-I "Makes of Sub-vendors Items" , volume II-B, section-C. Any addition /deletion of sub vendors by Customer during detail engineering shall no have any commercial implication. Bidder shall confirm the compliance	CONFIRMED
1.07	The material offered is equal or better in grade than specified. Bidder shall confirm the compliance.	CONFIRMED

1.08	Bidder to note and confirm that there will be no price implication for variation in Span, Lift and baylength upto ± 500 mm. Bidder to confirm	CONFIRMED
1.09	Bush as a antifriction bearing shall not be used. Bidder shall confirm the compliance	CONFIRMED
2.00	ELECTRICALS	
2.01	CABLES	
a	All CONTROL AND POWER cables shall be as per electrical specification (in technical specification PE-TS-372-501-A001). Bidder shall confirm the compliance	CONFIRMED
b	Cable required between isolating switch / change over switch and DSL included in the scope. Bidder to confirm the same.	CONFIRMED
2.02	MOTORS	
a	Class of insulation of Sq. cage motors shall be "F" and the temperature rise to limited to class B. Bidder shall confirm the compliance	CONFIRMED
b	Motor size shall be subjected to the approval of motor calculation. Bidder shall confirm the compliance	CONFIRMED
c	The successful bidder shall submit the data sheet -C of LV motors during detailed engineering and the same is subjected to customer approval without any cost implication on account of the same. Bidder shall confirm the compliance	CONFIRMED
d	Bidder to electrical specification for Marib enclosed with technical specification. In case of any conflict between various sections of specification then the more stringent requirement as per the interpretation of the customer shall be complied.	CONFIRMED
3.00	Bidder to confirm the compliance of scope of supply & services as per technical specification (PE-TS-372-501-A001, Rev 00)	CONFIRMED


VOLUME III
SCHEDULES

[illegible]

	SCHEDULE OF WEIGHTS AND DIMENSIONS TECHNICAL SPECIFICATION DOUBLE GIRDER EOT CRANE 400 MW MARIB GTPC, STAGE V	SPECIFICATION NO.: PE-TS-372-501-A001	
		VOLUME III	
		SHEET	OF
() From general terms and conditions of contract and special condition of contract (Vol. I) () From technical specifications (Vol. II B) () From general terms and conditions of contract for erection (vol. I) () From general technical conditions (Vol. IIC)			

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE			
NAME	DESIGNATION	SIGN DATE	COMPANY SEAL

PARICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGN	DATE	COMPANY SEAL

	<p align="center"> SCHEDULE OF DEVIATION TECHNICAL SPECIFICATION DOUBLE GIRDER EOT CRANE 400 MW MARIB GTPS STAGE V </p>		SPECIFICATION NO.: PE-TS-372-501-A001	
			VOLUME III	
			SHEET	OF

() From general terms and conditions of contract and special condition of contract (Vol. I)
() From technical specifications (Vol. II B)
() From general terms and conditions of contract for erection (vol. I)
() From general technical conditions (Vol. IIC)
Note: Each type of deviation shall be listed on a separate sheet.

We the undersigned hereby certify that the above-mentioned information's are the ONLY deviations.

PARICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGN	DATE	COMPANY SEAL

(TECHNICAL SPECIFICATION FOR ELECTRICAL PORTION)

ELECTRICAL SPECIFICATION

Equipment and services to be provided by bidder



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER EOT CRANES
(ELECTRICAL PORTION)

SPECIFICATION NO. PE-TS-372-501-A001
VOLUME II B
SECTION-C
REV 00 DATE 28.05.12
PAGE 1 OF 1

ELECTRICAL EQUIPMENT SPECIFICATION FOR DOUBLE GIRDER EOT CRANES

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section - C [ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish 400V AC loads required for the system (such as motor feeders) in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2, 4.3 & 4.4 below.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for Double Girder EOT Cranes" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical Scope between BHEL & vendor (Annexure-I).
- 4.2 Technical specification and Data Sheets for 400V Electric Motors.
- 4.3 Technical Specification for Power, Control, Instrumentation Control Cable & Miscellaneous electrical item
- 4.4 Quality Plan for motors, Power, Control & Screened control cables.
- 4.5 Load data format (Annexure-II).

Electrical scope between BHEL and vendor

ANNEXURE-I ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: MARIB 400MW GTPS PROJECT, PHASE-II

PACKAGE : EOT CRANES / ELECTRIC HOISTS

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	400V Local Starter and Control Panel (including Local Push button station, if applicable)	Vendor	Vendor	BHEL will provide two/one number 400 V supply feeders at 1.5 M from finish floor level. Any other voltage level (AC/DC) required will be derived by the vendor. Any other local panels if required shall be in vendor scope.
2	Power cables, control cables and screened control cables between equipment supplied by vendor.	Vendor	Vendor	Any special type of cable like compensating. Co-axial, prefab, MICC and fibre optical will be in vendor's scope.
3	Cabling material (Cable trays, Accessories, Cable tray supporting system, Conduits, conduit accessories etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipments metallic enclosures / frames, metal structure etc. shall be grounded at two points by vendor, each to the nearest grounding points / risers provided by BHEL at finish floor level.
5	Motors with base frame and fixing hardware for motors.	Vendor	Vendor	
6	Cable glands and lugs for all equipment supplied by vendor (This also includes glands and lugs for equipment supplied by vendor for which the other end is in BHEL's scope.)	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands (suitable for selected cable size). 2. Solder less crimping type tinned copper heavy duty lugs for copper conductor power cables 3. Solder less crimping type heavy duty copper lugs for Control cables.
7	Marshalling boxes / Junction Boxes including Power, Control and Instrumentation and special cable Junction Boxes.	Vendor	Vendor	
8	Illumination on EOT crane/hoists	Vendor	Vendor	
9	a) Input cable schedules. b) Cable interconnection details. c) Cable block diagram.	Vendor Vendor Vendor	- - -	Cable listing for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
10	Equipment layout drawings and Cable tray layout drawings.	Vendor	-	
11	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

Note:

1. Make of all electrical equipments/ items supplied shall be of reputed make & shall be subject to approval of BHEL/ Customer after award of contract.
2. All QPs shall be subject to approval of BHEL/ Customer after award of contract.
3. Soft Copy of Cable Schedule in the Cable Schedule Format Shall Be Furnished By Vendor After Award of Contract.

Electrical Specification for LV motors

400 MW MARIB GTPS PHASE-II, YEMEN

PROJECT INFORMATION-REV00

1.	Owner	PUBLIC ELECTRICITY CORPORATION, MINISTRY OF ELECTRICITY AND ENERGY , REPUBLIC OF YEMEN
2.	Project	400 MW MARIB GTPS PHASE-II
3.	Owner's consultant	The Kuljian corporation , Philadelphia , USA
4.	Location	Marib , Yemen
5.	Nearest Airport	El Rahaba Airport (SAH), Sana'a, Yemen
6.	Nearest Railway Station	No rail network in Yemen
7.	Access to site	<p>a. <u>Through sea</u>:</p> <ul style="list-style-type: none"> Distance of site: From Aden Port (Gulf of Aden): 419 Km <p>b. <u>By Air</u> : Sana'a Airport</p> <ul style="list-style-type: none"> Distance from site : 172 Km
8.	Site data	
A	Altitude	1100 m above Mean Sea Level
B	Ambient Air Temperature	45 °C

	1. Design Minimum Temp.	-----
C	RELATIVE HUMIDITY	
	Design Relative Humidity	60%
D	RAINFALL	
1.	Average Rainfall per annum	< 100 mm
E	WIND VELOCITY & PRESSURE	
1.	Max. Design Wind Velocity	120 km/h
2.	Max. Barometric Pressure Barometric Pressure at sea level	1023.6 mbar 887.7 mbar
F	SEISMIC ZONE	UBC 1997,Zone-2 A
9.0		
A	Design Ambient temperature for Gas Turbine & Mechanical equipment	45 °C
B	Design Ambient temperature of electrical equipment	50 °C
10.0	Electrical Details	Refer attached Anx-I

Electrical Power Sources and Equipment Voltage Rating

ANX-I

- i. 400,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
- ii. 33,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
- iii. 6600±10% volts, 3-phase, 50 Hz, low resistance grounded system.
- iv. 400±10% volts, 3-phase, 50 Hz, solidly grounded system
- v. 230±10% volts, 1-phase, 50 Hz, (PH/N of 400 volt) for lighting, receptacles and small power
- vi. AC 230 ± 5% volts, 50 Hz, 1-phase, for instrumentation and controls.
- vii. 220V / 125 / 24 / 48V (+) 10% to (-) 15% volts (DC), ungrounded system

Electric Equipment Voltage Rating

AC Equipment Voltage Rating

- | | | | |
|------|--------------------------------------|---|---------------------|
| i. | Motors larger than 250 kW | : | 6.6 KV, 3-ph, 50 Hz |
| ii. | Motors less than and equal to 250 kW | : | 400V, 3-ph, 50 Hz |
| iii. | Lighting with associated equipment | : | 230V, 1-ph, 50 Hz |
| iv. | MOV motors | : | 400V, 3-ph, 50 Hz |

Frequency : 50 Hz ± 5%

Fault Level

- | | | | |
|------|----------------------|---|---|
| i. | 400,000 volts system | : | 31.5KA for 3 sec. (In line with Phase - I) |
| ii. | 33,000 volts system | : | 31 kA for 3 sec. (In line with Phase - I) |
| iii. | 6600 volts system | : | 25 kA for 3 sec. (In line with Phase - I) |
| iv. | 400 volts system | : | Min. 50 kA for 1 sec. in line with Phase-I to be uprated based on calculation to be submitted for Phase - II. |
| v. | DC system | : | By Bidder for 1 sec. |

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME .400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				1

8.8	ELECTRIC MOTORS AND ACTUATORS
8.8.1	General <p>This specification covers the design, manufacture, supply, erection, testing and commissioning of Motors for various driven equipment and Actuators.</p> <p>It is not the intent to specify completely herein all details of the equipment, nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.</p> <p>Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.</p>
8.8.2	Scope of work <p>The scope of work shall include but not limited to the following:</p> <ul style="list-style-type: none">- AC & DC Motors required for various application- Actuators required for various applications.- List of recommended spare parts as per Section-10.0, Vol.-II.- Commissioning spares.
8.8.3	Technical Requirements <p>Motors shall confirm to IEC and other applicable international standards amended upto date. Equivalent ANSI standards are also acceptable.</p>
8.8.3.1	Motors <p>Design Features</p> <p>All AC motors shall be squirrel cage three phase/ single phase induction motors. Lifts/Crane motors may be of slip ring type. DC motor shall generally be of shunt wound type rated for 220 V DC. DC motors shall be sized for operation with fixed resistance starter for maximum reliability. DC motors under GTG package may be rated for 220V DC. All motors shall be rated for continuous duty. Crane motors shall be rated for intermittent duty.</p> <p>Inching type motors as per the requirement shall be provided.</p> <p>The motor rating shall be at least 15% (service factor) over the maximum input power requirement of the driven equipment at rated point.</p> <p>Continuously operating motors shall be of high efficiency type.</p> <p>Power supply for AC motors shall be as follows:</p> <ul style="list-style-type: none">- Motors less than and equal to : 400 V, 3 Phase, 50 Hz solidly grounded system 250 kW- Motors larger than 250 kW : 6.6kV, 3 Phase, 50 Hz. resistance grounded system

FORMT9-P REV-0

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				2

Motors shall be capable of delivering the rated output with supply voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$ and absolute sum of 10% .

The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, breakdown and full load torques are available for the intended service.

Squirrel cage induction motors shall be designed for direct on line starting Starting current shall not exceed 600% of full load current with 20% tolerance for ratings upto and including 1000 kW . For motors rated above 1000 kW , starting current shall be limited to 600% of full load current without any tolerance.

The starting current of 220V motors shall be restricted to 200% of full load current whereas for 125V motors, the same shall be restricted to 160% .

The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals. Motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. Permissible number of starts per hour for continuous duty motors shall be as follows.

Starts	No. of Starts
No. of hourly startups uniformly distributed, starting from final steady working temperature (Hot)	3
No. of consecutive startups with initial temperature of motor at final steady working temperature (Hot)	2

Motors subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energised shaft rotating at 125% of rated speed in reverse direction.

The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors with 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time. Starting time shall be at the minimum permissible voltage of 80% rated voltage. If the above conditions cannot be met in unavoidable cases, special provisions such as motor shaft speed switch, etc. shall be provided. Hot thermal withstand curve shall have 3 margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

The motor shall be designed to withstand any torsional and / or high current stresses which may result during bus transfer, without experiencing any deterioration in the normal life & performance characteristics.

FORMS-P REV.B

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				3

8.8.3.2 Constructional details

Enclosure

Motors located indoor shall have IP 44 degree of protection and those located outdoor shall have IPW 55 degree of protection for the enclosure. For hazardous areas, approved type of flameproof and increased safety enclosure shall be provided.

The motors shall generally be of self ventilated type totally enclosed fan cooled (TEFC). Alternatively for large motors, closed air Circuit Air Cooled (CACAC) System shall be adopted.

Winding and Insulation

The winding for all the motors shall be of super enameled copper wire of suitable gauge or copper strip conductor depending on its rating. All motors shall be class F insulated limiting temperature rise to class B limit.

The windings, fittings and hardware shall be corrosion resistant. The windings shall be tropicalised and shall be impregnated to make them non-hygroscopic and oil resistant.

Main insulation and inter turn insulation of Motors shall be capable of withstanding switching surges as per IEC 34, Part 15.

Motors of rating 37 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. The space heater shall be rated for 230 V, single phase, 50 Hz, and sized to maintain the motor internal temperature above dew point when the motor is idle.

All HT motors shall be provided with six (6) duplex type winding temperature detectors, two (2) per phase and the motor bearing shall be provided with 2 Nos. duplex type temperature detectors on driving end and non driving end. These temperature detectors shall be resistance type, 3 wire, platinum wound, 100 ohms at 0°C. The temperature detectors shall be connected to the DCS system.

Bearings

Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type are preferred.

Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

Provide one pt-100 RTD or chromed – constant type E thermocouple, temperature measurement thermocouples, on bearing or oil reservoir associated with an anti-friction on thrust bearing.

Lubricant shall not deteriorate under all service conditions. The lubricants shall be limited to normally available types.

Bearings shall be insulated as required to prevent shaft current and resultant bearing damage for a motor rating of above 1000 kW.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				4

In case forced lubrication is adopted, a shaft driven oil pump shall be provided along with an electrical auxiliary pump. Alternatively, two motor driven pumps may be provided, one working and one standby. All necessary auxiliaries and accessories shall be provided to complete the system. A pressure gauge and pressure switch for low oil pressure warning and to start the standby oil pump automatically shall also be provided. A motor driven jacking oil pump may be provided, for heavy shaft loads.

Indicator/Switch

Dial type local indicator with alarm contacts shall be provided for the following:

- HT motor bearing temperature
- Hot and cold air temperatures of the closed air circuit for CACA motors.

Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V D.C. and 5A at 230 V A.C.

Motor Terminal Box

Motor terminal boxes shall be provided with a detachable extension box (cable core splitter box). Terminal box shall be capable of being turned 360° in steps of 90°, unless otherwise approved. The terminal boxes shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. The terminal box shall have sufficient space inside for termination/connection of cables.

Terminals shall be of stud type, substantially constructed and thoroughly insulated from the frame. The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor. The terminal box shall be capable of withstanding maximum system fault current for 0.2 sec for all breaker operated motors and shall be provided with explosion vent. However for contactor operated motors, the terminal box shall be capable of withstanding the fault current for let through time of the fuse preceding it.

For 6600 V motor (if required), the terminal box shall be phase segregated type and neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection. For motors for 1000 kW and above, PS class current transformers shall be provided in the neutral side terminal box on all three connections for differential relay.

All accessory equipment such as space heater temperature detector, etc., shall be wired and terminated in a enclosure, separate from motor (power) terminal box. The degree of protection for accessory terminal box shall be same as that of motor. Terminal box shall be complete with double compression brass glands and stud type terminals and shall be suitably mounted on the side of the motor. If possible, the accessory terminal boxes shall be located on the same side of the motor as the main (power) terminal box.

Earthing Terminals

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

FORMTS-P REV-B

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				5

The cable terminal box shall have a separate grounding terminal.

Noise & Vibration

The noise level and vibration limits shall not exceed the limits specified in relevant ANSI / IEEE / IEC standards.

Rating Plate

The motors shall be provided with a rating plate of stainless steel.

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

- Temperature rise in °C under rated condition & method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

Lifting

All electric motors shall be provided with lifting lugs.

8.8.4 DRAWINGS, DATA & MANUALS

To be submitted with the Bid.

List of electric motor actuators

Type test certificates on similar equipment

To be furnished for Approval and Distribution. (After award of contract)

Actuator data sheet

Internal wiring diagram

Torque switch and limit switch contact development.

Manufacturer's catalogue.

Any other relevant drawings, documents, or data necessary for satisfactory installation, operation and manufacturing.

Instruction Manuals for Actuators

The manuals shall clearly indicate method of installation, check-ups and tests to be carried out before commissioning of the equipment.

The Bidder may note that the drawings, data and manuals listed are herein minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves, calculations and information required to fully describe the equipment are submitted with his bid.

FORMTSP REV-B

Specific design data for motors (Data sheet A)

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				7

8.8.5 Specified Design Data

SECTION : ELECTRIC MOTORS & ACTUATORS		
8.8.5.1 AC Motors		
Rated Voltage		
Less than and equal to 250 kW	V	400
Larger than 250 kW	V	6600 V
Rated Frequency	Hz	50
Voltage variation		±10%
Frequency Variation		±5%
Absolute sum of variation		10%
Rated Voltage for DC Motors	V	220 V ±10% to -15% (125 +10% to -15% if GTG supplier's standard)
Class of Insulation for all Motors		Class 'F' with temperature Limited to Class 'B'
Starting Current		6 times FLC.
Degree of protection		IP 44/IP W 55
Method of cooling		TEFC/CACA
Fault withstand capability of terminal box		Fault current for 0.2 sec. for breaker controlled motors
No. of consecutive hot starts with initial temperature of motor at final steady working temperature		Two
No.of hourly starts uniformly distributed from final temperature		Three (3)

FORMT9-P REV-B

Data sheet-C– LV motors

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				8

8.8.6 Technical Data by the Tenderer

SECTION : ELECTRIC MOTORS & ACTUATORS

8.8.6.1 MOTORS (Bidder to fill data for each type and rating of motor)

General

* Application

-

* Quantity

Nos

* Make & Country

-

Frame size

-

Applicable standard

-

Type of motor

-

* Service

-

* Rating

kW

Duty cycle/ designation

-

Rated continuous output at max. ambient

kW

Rated speed

rpm

* Rated voltage and Voltage variation range

V
%

* Rated frequency and Frequency variation range

Hz
%

Full load current

A

No load current

A

Rated power factor

-

Efficiency at rated voltage and frequency

Full load

%

Three quarter

50% load

%

FORMT9-P REV-B

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				9

Method of starting	-	
Starting current at rated voltage (as % of full load current)	%	
Starting current at 80% of rated voltage (as % of full load current)	%	
Starting torque (as % of full load torque)	%	
Time to attain full speed		
- with load	s	
- without load	s	
Locked rotor withstand time		
- from cold	s	
- from hot	s	
* Degree of protection of enclosure		
Method of cooling	-	
* Insulation class	-	
* Temperature rise over max. ambient	°C	
No. of hot starts		
Winding connection	-	
Bearing	-	
Make	-	
Type	-	
Recommended lubricant	-	
Motor Terminal Box		
Type	-	
Fault with-stand current and time	kA, s	
Number of grounding pads provided		
- On motor body	-	
- On terminal box	-	
Type of mounting	-	


FORM19-P REV-B


Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
				Sheet No.
				10

Overall dimensions		
Length	mm	
Breadth	mm	
Height	mm	
Weight		
Stator	kg	
Rotor	kg	
Total	kg	
Moment of inertia		
Stator	kg.sq.m	
Rotor	kg.sq.m	
Total	kg.sq.m	
Dynamic load and foundation	-	
Drawings furnished	Yes/No	
General arrangements	Yes/No	
Terminal box details	Yes/No	
Torque vs speed (at 100% rated voltage, at 80% rated voltage at 110% rated voltage) with the driven equipment torque speed curve super imposed.	Yes/No	
Thermal withstand curves (hot & cold)	Yes/No	
Locked rotor curves (hot & cold)	Yes/No	
Starting characteristics (at 80% rated voltage and at 100% rated voltage.	Yes/No	
Performance curves (output vs efficiency, output vs current output vs slip	Yes/No	
10% margin considered for motor rating above the rated shaft power requirement.	Yes/No	
15% margin considered for BFP and GBC motor	Yes/No	


FORMT9-P REV-B


Quality Plan for AC motors below 55 KW (LV)


		QUALITY PLAN SHEET 1 OF 2		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION			
		SYSTEM		NUMBER PED-506-00-Q-006, REV-01			TITLE			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./MFG. SPEC.	MFG. DRG./MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									


		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ :			TITLE			NUMBER :		
				VENDOR			QUALITY PLAN			SPECIFICATION :		
SHEET 2 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
<p>NOTES:</p> <p>1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER</p> <p>2. VENDOR (MOTOR MANUFACTURER)</p> <p>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM</p> <p>W. WITNESS</p> <p>V. VERIFY</p>												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


Quality Plan for AC motors 55KW & above 55 KW


		QUALITY PLAN SHEET 1 OF 9		CUSTOMER		PROJECT TITLE			SPECIFICATION NUMBER			
				BIDDER/VENDOR		QUALITY PLAN			SPECIFICATION TITLE			
				SYSTEM		NUMBER PED-506-00-Q-007, REV-03			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			VOLUME III
1	2	3	4	5	6	7	8	9	10	P	W	V
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BH&L			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


		QUALITY PLAN		CUSTOMER		PROJECT TITLE			SPECIFICATION NUMBER			
SHEET 2 OF 9				BIDDER/VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4. INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


				CUSTOMER		PROJECT			SPECIFICATION			
		QUALITY PLAN		BIDDER/		TITLE			NUMBER			
				VENDOR		QUALITY PLAN			SPECIFICATION			
				SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			
		SHEET 3 OF 9				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			
									VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUF'R'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUF'R'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- - -	- 2 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH.TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


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

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

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

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

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER		PROJECT TITLE			SPECIFICATION NUMBER			
				BIDDER/VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	* NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^s	1	* NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	* NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	* NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^s	1	* NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^s	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY * NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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

General technical Requirements of Power and control cables

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No.
				1

8.14 POWER AND CONTROL CABLES

8.14.1 General

This specification covers the design, manufacture, supply, erection, testing and commissioning of Power and Control Cables.

It is not the intent to specify completely herein all details of the equipment, nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.

8.14.2 Scope of work

The scope of work shall include but not limited to the following:

6.6 kV, XLPE unearthed grade power cables

1000 V, XLPE power cables

1000 V grade XLPE control cables

Special cables for excitation system etc.

Special cables for cranes, hoists, etc.

Heat resistant cables.

Fire proof cables

List of recommended spare parts as per Section-10.0, Vol:-II.

Commissioning spares.

8.14.3 Technical requirements

8.14.3.1 Design Features

The cables shall be suitable for laying on overhead cable trays or on cable trays in trenches. Buried cables in ground may be used for small number cable runs to outlying areas of the Plant

Cables shall be adequately sized considering

- Full load current
- Short circuit current and duration
- Voltage drop during starting & running condition
- Ambient temperature
- Grouping and installation conditions
- Soil resistivity (for buried cables)
- Earth fault current (for sizing screen and armour)
- To limit the cables to some standard sizes instead of using too many sizes.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14 Sheet No. 2

For breaker protected circuits minimum size will be determined by short circuit rating for a duration of 0.2 sec. for 400 V and 6.6 kV feeders.

Ambient air temperature shall be considered as 50°C. Overall derating factor for cable shall be based on the above factors..

Separate cables shall be provided for circuit of different plant and auxiliaries for different voltage levels and for circuits fused separately. Power, control and instrumentation circuits shall be taken through separate cables.

XLPE insulated cables shall be suitable for continuous conductor temperature of 90°C and short circuit withstand temperature of 250°C.

Cables installed in hot areas shall be specially designed for that ambient temperature. The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be enough to withstand mechanical stresses during handling.

Cables shall be adequately sized to take care of any derating due to fire stop cable sealing/fire resistant coating.

Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop at motor terminals during starting of motors shall be limited to 15% of the rated voltage.

Voltage drop in cable from MLDB to any lighting fixture shall not exceed 3% under steady state.

All the cables shall be FRLS type. Cable outer sheath shall have following flame retardant low smoke type (FRLS) properties.

- Oxygen index of not less than 29 when tested as per ASTM D 2863.
- Smoke density of not more than 60% when tested as per ASTM D 2843.
- Acid gas emission of not more than 20% by weight when tested as per IEC-754 I.

The cables shall meet flammability test requirement as per IEEE-383 and SS 4241475 (Category F3)

Minimum size of power cables shall not be less than 2.5 sq.mm copper. Minimum size of control cables shall be not less than 2.5 sq.mm copper and maximum no. of cores shall be limited to 19. Cables upto 7 core will have atleast 1 spare conductor, 12C and 19C cables will have atleast 2 spare conductor.

All the cables PVC shall be protected against rodent and termite attack. Necessary chemicals shall be added in to the PVC compound of the outer sheath.

All the single core cables shall be provided with non magnetic Aluminum wire armour & single round wire of galvanised steel for multicore cables.

Fire survival cables with withstand rating of 3 hours at 750°C shall be provided for emergency application such as DC emergency oil pump, turning gear, Jacking oil pump, emergency control, fire fighting, interconnection of DC battery, charger, DCDB, turbine / generator protection panel, DC emergency lighting and essential communication system.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No.
				3

8.14.3.2 Constructional Features

6.6 kV cables

These Cables shall be of single core / multicore, (class – 2 as per IEC) stranded copper conductor, XLPE insulated, extruded PVC inner sheathed conforming to multicore cables and single core cables shall have no inner sheath, armoured and extruded FRLS - PVC outer sheathed.

The 6.6 kV power cables shall be of 6000 V /10000 V grade suitable for use in 6.6 kV \pm 10%, 50 Hz \pm 5%, 3 phase resistance earthed system.

The 6.6 kV cables shall be provided with both conductor and insulation screening. Insulation screen shall consist of extruded semi conducting layer as per ICEA-S – 68 –516, S-66-524 & UL-1072 and bare copper shield. The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers.

LV Power Cables

The LV power cables shall be of 1000 V grade suitable for use in 400 V \pm 10%, 3 phase, 50 Hz \pm 5%, solidly grounded system and also for 220 V DC ungrounded system.

The LV Power cables shall be of heavy duty power cables with stranded copper conductors, XLPE insulated, extruded PVC inner sheathed conforming to ST2 compound armoured and extruded FRLS – PVC outer sheathed.

Control Cables

The control cables shall be 1000 V grade, multicore stranded annealed copper conductor having high conductivity, XLPE insulated, cores laid up, extruded PVC inner sheathed conforming to ST-2 compound armoured and extruded FRLS – PVC outer sheathed cable.

Cable drum

Cable drums shall be made of good quality wood, pressure impregnated against fungal and insect attack. The ends of each length of cable shall be sealed before despatch.

8.14.4 Drawings, Data & Manuals

To be submitted with the Bid

Manufacturer's catalogues giving cable construction details and characteristics

Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables

Type test certificates on all specified cables

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No.
				4

To be submitted for Approval and Distribution (After award of contract)

Guaranteed cable data

Instruction Manuals for Power and Control Cables

The manuals shall clearly indicate method of installation, check-ups and tests to be carried out before commissioning of the equipment.

The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves, calculations and information required to fully describe the equipment offered are submitted with the bid.

Specific design data for Cables – Power & Control (Data sheet A)

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No.
				5

8.14.5 Specified Design Data

SECTION : POWER & CONTROL CABLES

8.14.5.1 6.6 kV cables

Voltage Grade	kV	6 / 10 kV, 90°C rating heavy duty
Core	-	Single / three
Conductor	-	Class 2 (as per IEC) standard copper
Conductor screen	-	Semiconducting compound
Insulation	-	XLPE
Insulation screen	-	
- Metallic part		Copper wire/tape
- Non metallic part		Semiconducting compound
Innersheath		Extruded PVC conforming to ST-2
Outersheath		FRLS – PVC
Armour		Galvanised round steel wire for multicore Aluminium wire for single core

8.14.5.2 LV Power Cables

Voltage grade	V	1000, 50 Hz. solidly earthed
Frequency , earthing system		
Core		1 / 2 / 3 / 3½ / 4 core
Conductor	-	Stranded Copper
Insulation	-	XLPE
Innersheath	-	Extruded PVC conforming to ST-2
Outersheath		FRLS – PVC
Armour		Galvanised steel for multicore Aluminium wire for single core

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No.
				6

8.14.5.3 Control cables

Voltage Grade

kV

1000

Core

Maximum 19

Conductor

-

Stranded Copper (min 2.5 mm²)

Insulation

-

XLPE

Innersheath

-

Extruded PVC conforming to ST2

Outersheath

FRLS – PVC

Armour

Galvanised steel

8.14.5.4 FRLS Properties

Oxygen index

-

Not less than 29

Smoke density

-

Not more than 60%

Acid gas generation

-

Not more than 20% by weight

Data sheet-C– Cables

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14 Sheet No. 7

8.14.6 Technical Data by the Tenderer

SECTION : POWER & CONTROL CABLES

CABLES

The bidder shall indicate the following for each type 6.6kV, 400V, Power, Control cables & special cables and size of cables as per the format

- Make & Country

- Type

- Applicable standard

- Voltage grade

- Suitable for system with

- Service voltage

- Maximum Conductor Temperature

- Continuous

- Short time

Conductor

- Material

- Size

Number and diameter of wire in each conductor
no./mm

Screening on conductor

- Material

- Type

Thickness

Whether extruded

Insulation

- Material

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC - ME 400 MW MARIB GTPS - II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No.
				8

- Type	-	
Thickness	mm	
Screening on insulation		
- Material	-	
- Type	-	
Thickness	-	
Inner sheath		
- Material	-	
- Type	-	
Thickness	mm	
Extruded	Yes/No	
Approximate outside diameter over sheath	mm	
Armouring	-	
- Material	-	
- Type	no x dia	
DC resistance at 20°C	ohm/km	
Outer sheath		
- Material	-	
- Type	-	
Thickness	mm	
Approximate overall diameter	mm	
- Standard drum length with tolerance	mm	
Net weight of cable	kg/km	
Continuous current rating for standard IEC condition laid direct		
- In ground	A	
- In duct	A	

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14 Sheet No. 9

- In air	A	
Short circuit rating	-	
- Short circuit current for 1 second	kA	
- Conductor temperature allowed for the short circuit duty	°C	
Electrical parameters at maximum operating temperature,	-	
Conductor resistance	ohm/km	
Insulation resistance	ohm/km	
Reactance at 50 C/s	ohm/km	
Impedance	ohm/km	
Recommended minimum bending radius	-	
Derating factor for following ambient temperature in air/ ground at		
- 30 deg C	-	
- 35 deg C	-	
- 40 deg C	-	
- 42 deg C	-	
- 45 deg C	-	
- 50 deg C	-	
Group factor for following number of cables laid touching/ 2 x diameter centre to centre apart		
Multicore cable		
- 3 nos.	-	
- 4 nos.	-	
- 5 nos.	-	
- 6 nos.	-	
Single line to ground fault current withstand capability of screen	kA	
Single line to ground fault current withstand capability of armour	kA	
Whether type test certificates for similar type of cables enclosed with the bid ?	Yes/No	
Cable sectional details submitted ?	Yes/No	

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
				Sheet No. 10

FRLS Properties

- Oxygen index
- Smoke density
- Acid gas emission

Note:- Data marked * thus shall be filled up by the Bidder along with the offer. Completely filled data sheet are to be submitted by successful Bidder.

**Misc. electrical items (Technical specification for
Cable Trays and Accessories (including typical details
of cable trays)**

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15
				Sheet No.
				1

8.15 Miscellaneous Electrical Items

8.15.1 General

This specification covers the design, manufacture, supply, erection, testing and commissioning of Miscellaneous Electrical Items.

It is not the intent to specify completely herein all details of the equipment, nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.

8.15.2 Scope of work

The scope of work shall include but not limited to the following:

- ✓ Cable Trays and Accessories (Applicable)
- ✗ Cable termination and jointing kits. (Not Applicable)
- ✗ Cable ties, clamps and markers (Not Applicable)
- ✓ Receptacles. (Applicable)
- ✓ Conduits and accessories. (Applicable)
- ✓ Junction boxes. (Applicable)
- ✓ Cable glands and cable lugs. (Applicable)
- ✗ Fire stop cable sealing system. (Not Applicable)
- ✓ List and supply of Maintenance tools and tackles. (Applicable)
- ✓ List of recommended spare parts as per Section 10.0, Vol. II. ~~Not Applicable~~ (Applicable)
- ✓ Commissioning spares. (Applicable)

All accessories, fittings, supports, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

8.15.3 Technical Requirements

All the items shall conform to latest edition of relevant IEC standards amended upto date. Equivalent ANSI standards are also acceptable.

8.15.3.1 Cable Trays and Cable Tray Supports

Cable trays shall be pre-fabricated ladder type, made of 3 mm thick sheet steel with hot dip galvanized furnished in standard lengths of not less than 2.5 m. Cable trays of tough FRP

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15
				Sheet No.
				2

material may also be used especially in DM plants and corrosive chemical laden atmospheres / areas.

Cable trays shall be complete with all necessary hot dip galvanized sheet steel accessories such as coupler plates, ground continuity connections, nuts, bolts, washers, clamps etc. Also necessary horizontal/ vertical bends, horizontal/vertical Tees, Reducers, Horizontal cross pieces etc. shall be supplied to make the system complete.

Cable tray support system shall be of sheet steel prefabricated and galvanised or of site fabricated and painted type.

Sheet steel covers of minimum 2 mm. thick shall be provided for wall/column mounted vertical raceways and wherever specifically required. The width of the cover shall be same as that of the tray.

8.15.3.2 Cable Termination & Jointing Kits

The cable termination and jointing kits shall be either "Heat Shrink" / "Cold Shrunk" / Push ON type. The kits shall include all insulation and sealing materials apart from conductor fittings and consumable items. Joints and terminations shall meet test requirements as per IEC/ VDE 0278. The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water or overhead tray installation.

Cable ties & trefoil clamps shall be of special nylon high tensile material. Cable markers shall be of aluminium.

8.15.3.3 Conduits and Accessories

Conduits shall be of rigid steel, hot-dip galvanized, furnished in standard lengths threaded at both ends. Minimum diameter of conduits shall be 20 mm. All conduits shall be heavy duty suitable for electrical installation. Sizing of conduit shall be based on maximum 40% fill criteria. Conduits shall be complete with all accessories such as bends, ties, couples, inspection box, etc.

Flexible conduits where required, near equipment terminations, shall be made with bright, cold rolled, annealed and electro-galvanized mild steel strips. In corrosive areas, epoxy coated conduits shall be provided.

8.15.3.4 Receptacles

Industrial Receptacles

The industrial receptacles shall be heavy duty type rated for 20 A, 230V AC complete with plug and switch housed in galvanised sheet steel enclosure having degree of protection of IP 55. These shall be of three pin type with the third terminal connected to earth. Receptacles shall be provided in all the indoor and semi indoor areas such that the any point is accessible within 25m of cabling distance from the receptacle. For outdoor area also necessary receptacles shall be provided as per owners requirement to be indicated during detailed engineering. Receptacles shall be provided in all the buildings of auxiliary equipment, GTG area and Transformer yard. The receptacle shall have safety shutters and other safety interlocks for safe operation.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15
				Sheet No.
				3

Flush type indoor receptacles

Flush type receptacles shall be provided for office rooms, control rooms and wherever false ceiling has been adopted. These shall be so located that only the plug projects outside and shall be rated for 5/15 A, 230V, AC. The receptacle shall be complete with switch housed in sheet steel enclosure.

Welding Receptacles

The welding receptacle to be supplied shall be of 63 A, industrial heavy duty type with 5pin (with earth connection) suitable for 400V, 3 phase, 50 Hz supply. In every enclosed area, for every 50 m interval, 1 No. receptacle shall be provided. For outdoor area, necessary receptacles shall be provided as per requirement. Receptacles shall be provided in all the buildings of auxiliary equipment, GTG area and Transformer yard.

The receptacle and switch shall be housed in a sheet steel enclosure complete with gasket, cable glands etc. All receptacle enclosures shall have 2 Nos. earthing terminals.

The enclosure shall be min. 2 mm. thick galvanized sheet steel and shall conform to the degree of protection IP-55 class.

All receptacles shall be provided with matching plug tops.

In hazardous areas, receptacles shall be of flame proof type.

The receptacle and switch shall be interlocked with the plug such that it shall not be possible to remove the plug with the switch in 'ON' position.

8.15.3.5 Junction Box

Junction boxes shall be conforming to degree of protection IP55. The boxes shall be of die cast aluminium (LM 6) complete with removable cover plate with gaskets, two earthing terminals, terminal blocks etc.

The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable/conduit entry knock outs & terminal blocks.

The terminal blocks shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 650 V grade, one piece construction complete with terminals, insulation barriers, galvanised nuts, bolts and washers and provided with identification strips of PVC. The terminals shall be made of copper alloy and shall be of box clamp type.

The terminals for junction boxes shall be suitable for terminating two (2) nos. 2.5 mm² stranded copper conductors on each side.

8.15.3.6 Cable Glands

Cable glands shall be tinned brass, shrouded, double compression type, complete with necessary armour clamp and tapered washers etc. Cable glands shall match with the different cable sizes.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15 Sheet No. 4

8.15.3.7 Cable Lugs

Cable lugs shall be tinned copper lugs suitable for termination of different sizes of HT/LT/ control cables. Lugs for power cables shall be of compression type, whereas lugs for control cables shall be of insulated terminal crimping type.

8.15.3.8 Fire Stop Cable Sealing System

In order to restrict the propagation of cable fire and spread of toxic smoke, the cable entry below switchgear panels/ control panel, cable penetration through walls and cable shafts on the floors need to be sealed by fire seal system.

Fire stop cable sealing shall have two (2) hours fire rating. The sealing compound shall have special property to allow for thermal expansion of cables both under normal and short circuit conditions. The sealing system shall be proven type and tested as per relevant standard.

Necessary fire proof doors in cable spreader rooms shall also be provided.

If required by the fire stop sealing system to achieve the fire rating of 2 hours, cable coating shall be adopted on cables. The coating shall have minimum two hours fire protection rating. Cables at least 1 m before & after the penetration seals shall be suitably coated. Cables shall be sized to take care of any derating due to fire stop sealing.

8.15.3.9 Name plates

Name plates shall be furnished for identification of devices and circuits. All terminals shall have permanent and legible markings.

8.15.4 Drawings, Data & Manuals

To be submitted with the Bid

General arrangement drawing showing constructional features, space required in front, rear, cable entry points etc.

Typical mounting details.

Bill of materials

Technical leaflets on :-

- i) Push buttons and indication lamps
- ii) Terminal blocks
- iii) Cable glands & lugs.
- iv) Ammeters

To be submitted for Approval and Distribution (After award of contract)

General arrangement drawing showing constructional features; space required in front, rear, cable entry points etc.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15
				Sheet No.
				5

Cross-section with parts list.

Mounting details.

Consolidated bill of materials

Control Schematics

Wiring diagrams.

Any other relevant drawings, document or data necessary for satisfactory installation, operation and maintenance.

Instruction Manuals for Local Control Panel/Local Control Station/Local junction Box

The manuals shall clearly indicate method of installation, check ups and tests to be carried out before carried out before commissioning of the equipment.

The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups and information required to fully describe the equipment are submitted with his bid.

Data sheet-A – Cable trays and Accessories

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15
				Sheet No.
				6

8.15.5 Specified Design Data

SECTION : MISC. ELECTRICAL ITEMS

8.15.5.1 Cable Trays-General

Type	-	Pre fabricated ladder type
Thickness	-	Not less than 3mm
Surface coating	-	Hot dip galvanised
For DM plant and corrosive chemical laden area	-	Tough FRP

8.15.5.2 Cable Terminations / joints

Type	-	Heat Shrink/ Cold shrink
------	---	--------------------------

8.15.5.3 Conduits

Type	-	Heavy duty
Material	-	Hot dip galvanised rigid steel

8.15.5.4 Fire seal system

Fire rating	-	min. 2 hours
-------------	---	--------------

Data sheet-C – Cable trays and Accessories

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15 Sheet No. 7

8.15.6 Technical Data by the Tenderer

SECTION : MISC. ELECTRICAL ITEMS

8.15.6.1 Cable Trays – Give separately for GI/Tough FRP

Make

-

Type

-

Thickness

mm

Material

-

Standard length

m

Weight per metre

kg

Size

mm

8.15.6.2 Cable tray support system

Make

-

Type

-

Whether Galvanised

Yes/No

Weight / Metre

kg

Size & Shape

8.15.6.3 Cable Terminations & joining kits

Make

-

Type

-

Applicable standard

-

8.15.6.4 Conduits

Make

-

Type

-

Size

mm

Thickness

Mm

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15 Sheet No. 8

Surface coating	-	
8.15.6.5 Receptacles		
Make	-	
Type	-	
Rating	A	
Applicable standard	-	
Voltage	V	
8.15.6.6 Junction Box		
Make	-	
Type	-	
Size	mm x mm	
Thickness	mm	
8.15.6.7 Cable glands		
Make	-	
Type	-	
Material	-	
Applicable standard	-	
Size	mm ²	
8.15.6.8 Cable lugs		
Make	-	
Type	-	
* Material	-	
Size	mm ²	
8.15.6.9 Fire sealing system		

FORM T9-P REV-B

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC - ME 400 MW MARIB GTPS - II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.15
				Sheet No.
				9

Make

Type

Fire rating

hour

Note :- Data marked * thus shall be filled up by the Bidder along with the offer. Completely filled data sheet are to be submitted by successful Bidder.

**General technical Requirements for cabling
installation (Cabling, wiring, junction boxes, earhitng
lighting, etc..**

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 141

17.4.5.0 Cabling, Wiring, Junction Boxes

Cabling

Single pair / 2 core cable shall be used for connection of field transmitters / switches to the respective junction boxes respectively. From junction boxes, multipair/multicore cables shall be used upto the CCR. For RTD's single triad/multi triad cables shall be used.

Screened
control
cable.

The cables shall be of stranded, tinned copper conductor, PVC insulated, shielding with mylar back aluminium tape with drain wire, GI round wire armoured, HRFRLS PVC inner and outer sheathing, 600V grade type.

For thermocouples, extension cables shall be used upto the temperature transmitters, where provided. However in very high temperature zones, mineral insulated cables shall be used.

The cable trays shall be fabricated from steel sheet - galvanized or coated with other corrosion resistant material. All fittings etc. shall also be of galvanized steel. The cable trays shall be sturdy in design and shall have adequate strength. The cable trays shall not have sharp edges, burrs or projections. Protective covers on trays shall be provided, wherever necessary. Space for atleast 20 percent future cables shall be kept in each tray.

Cable tray runs shall be made as straight as possible and shall avoid exposure of the cables to excessive heat, moisture, areas of strong electrical interferences and mechanical drainage. The minimum separation between parallel runs of power and signal wiring shall be 300 mm for L.T. and 1000 mm for H.T. cables.

✓ Wiring

In particular, wiring within cabinets and panels shall be supported on trays or ducts and shall be segregated according to voltage level. Wiring carrying A.C. and D.C. voltage shall also be segregated.

All cabinets, panels, and racks shall be factory wired. Where desks or panels area supplied in more than one section electrical connections between the sections shall be via terminal strips.

Spare cores shall be terminated at terminal strips in such a manner as to give a maximum length of core. These shall be ferruled in a special way to indicate that they are spare cores.

Terminal strips shall be of the screw type. Screw type terminals shall have a metal insert between screw and conductor. In the Central Control Room (CCR) advanced semi-automatic connection techniques (e.g. maxi terminal point, wire - wrap) are preferred. Wire wrap and terminal point connections shall be effected with the aid of an approved semi automatic or automatic, power operated hand tool.

✓ Junction Boxes

In order to simplify local collection of cables and distribution of signals and to centralize connections in the plant, junction boxes shall be provided. The junction boxes shall be designed to the protection class shall be NEMA 4X equipped with the necessary terminal strips, cable glands and attachment components for the connection of the cables. The necessary earthing terminals shall be provided for the earthing of the boxes. In any area

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	---
				Sheet No. 142

subject to the danger of explosion, the necessary explosion - protected boxes shall be provided in accordance with IEC 79 and VDE 0165/170/171 or equivalent.

17.4.6 Instrument Air Piping/Turbing

All pneumatic ~~turbing~~ connecting the instruments shall be in SS 316 unless otherwise agreed by the Purchaser. All instrument air header lines shall be in GI.

~~The piping ends shall be plugged prior to transportation~~

17.4.7 Painting

Inside housed desks, panels, cabinets, racks and other control equipment are to be supplied with the same colour of final painting. External surfaces shall be semi-gloss.

Local mounted cabinets, housing Control & Instrumentation equipment shall be protected against rust and corrosion by a protective coating such as galvanized zinc, which shall be applied as a first factory coat.

In all cases where site erection work exposes bare metal, such as the drilling or punching out of holes for cable or pipe entry, these areas shall be protected by the immediate application of a protective first coat similar to the original.

The shade and grade of paint are to be agreed to by the Purchaser and must harmonize with the overall architectural design.

Any machined or bright faces and parts which are not painted (e.g. of valves, fittings or accessories) must be protected against corrosion by suitable agents prior to installation.

After completion of installation and commissioning but before provisional taking over the Contractor shall make good all marks, scratches and damage to the painted surface of all desks, panels and cabinets irrespective of the cause. The Contractor shall also take every reasonable precaution to prevent damage during the course of erection and commissioning. Repairs to paintwork shall be carried out in such a way so as to restore the equipment to its original factory condition and shall be to the satisfaction of the Purchaser.

17.5.0 General Civil Requirements

~~The design specification covered in Section 10 of Vol V, establish the minimum basic requirements for all Civil structural and Architectural works. However all structures shall be designed for the satisfactory performance of the function for which the same are to be constructed.~~

~~With regard to soil and other hydrographic data furnished, it shall be clearly understood that the same are given to the bidders in good faith and as such no claim for extra payment shall be entertained by the Owner, if the actual condition met with during execution are at variance with the data given in tender. The bidder shall fully satisfy himself about the site conditions, nature of soil, ground water, contour levels, etc. prior to the submission of the bid. The bidder shall conduct his own investigations to ascertain the correctness of the data furnished.~~

17.5.1 Design Calculations and Drawings

~~Detailed design calculations / design drawings shall be commenced by Contractor only after approval is obtained from the Owner to the basic design criteria submitted by the Contractor. No deviation from the approved design criteria will be permitted unless specifically approved again by the Owner in writing, prior to its adoption.~~

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.10
				Sheet No.
				1

8.10 EARTHING & LIGHTNING PROTECTION

8.10.1 General

This specification covers the design, manufacture, supply, erection, testing and commissioning of Earthing and lightning protection system.

It is not the intent to specify completely herein all details of the equipment, nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.

8.10.2 Scope of work

The scope of work shall include but not limited to the following:

- System earthing with buried earth mats / electrodes for complete power plant
- Equipment earthing system
- Lightning protection system for all buildings, structures & equipments
- List of recommended spare parts as per Section-10.0, Vol.-II.
- Commissioning spares.
- Interconnection with the Phase – I Plant earthing system at 4 points.

8.10.3 Technical Requirements

8.10.3.1 Earthing System

Earthing system design shall be carried out as per ANSI / IEEE 80 and other relevant IEC standards.

For earth mat design, the size of the earthing conductor shall be arrived, considering the maximum fault current for a duration of 3 sec. and suitable corrosion factor. The spacing of the conductors shall be such that the touch and step potential are within the limits of permissible values. The earthing resistance shall be less than 1 ohm. The earthing system shall be designed for a life expectancy of atleast 30 years.

The contractor shall assess the soil quality and site conditions and design the grounding system accordingly. Necessary tests / measurements shall be carried out by the successful bidder to arrive at the actual soil resistivity.

The earthing system below ground level shall consist of interconnected mesh of copper wire rope buried at a depth of minimum 600 mm and vertical electrodes of lead coated copper rods. When the earthing conductor is laid beneath the building the depth of burial shall be increased so that sufficient earth coverage is available. The earthing conductor shall be of bare copper wire.

The earthing Grid at different areas of the power plant shall be interconnected by minimum 2 Nos. of conductors.

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.10
				Sheet No.
				2

For shielding towers / chimneys, the ground conductor shall be taken right upto the top along the tower / chimney structure & connected directly to the shielding mast wire / lightning mast.

All joints in the equipments shall be bonded to provide electrical continuity.

Vertical electrodes shall be of adequately sized lead coated of Copper rod, min. 3M long. Treated earth pits as required shall be provided. Vertical risers shall be provided at suitable place for connecting to equipment grounding conductors. The risers shall be bare copper wire. Equipment grounding conductors shall be copper flats (or) standard size of copper ground cable suitably sized to withstand the fault current of the system.

All electrical equipment shall be earthed by two separate and distinct earth connections with earth grid. Instrumentation DCS panels shall be earthed with two separate distinct earth connections to the two numbers exclusive earth pits.

8.10.3.2 Lightning protection system

Lightning protection system shall be carried out as per IEEE / ANSI and other IEC standards.

Lightning protection shall be provided for all equipment / buildings / structures higher than 20 metres and where the calculated risk index exceeds 40, with horizontal roof conductors for lightning protection.

Lightning protection system shall comprise vertical air terminations, horizontal air terminations, down conductors, test links and earth electrodes.

Air terminations, down conductors and test links shall be made of adequately sized lead coated copper rod and earth connection below ground level shall be of copper only.

Hazardous area shall be protected by a system of aerial earth as per IEEE 142.

The portion of the copper flat / wire rope which undergone welding at site shall be coated with two (2) coats of cold galvanising anti corrosive paint after welding.

8.10.4 Drawings, Data & Manual

To be submitted for Approval and Distribution (After award of Contract)

Calculation for determining the soil resistivity.

Calculation for grounding system design.

Grounding layout drawings of various plants with dimensions showing the location of main ground grid, ground electrodes, risers, grounding leads etc.

Calculation for lightning protection system design.

Layout of lightning protection system for various plants with dimensions showing location of vertical/horizontal air terminations, down conductors, risers, electrodes etc.

Details of materials and procedures for jointing/connections among various electrodes/risers/conductors.

**Specific design data - A (earthing & lighting
protection system)**

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.10
				Sheet No.
				3

8.10.5 Specified Design Data

SEC.: EARTHING & LIGHTNING PROTECTION SYSTEM		
EARTH MAT		
Fault withstand current	kA	As per system requirement
Earth fault current duration for conductor sizing	s	3 (minimum)
Conductor material	-	Copper wire rope
Ground electrode	-	Lead coated copper rod
Equipment Earthing		
Conductor	-	Copper flat / standard size of copper ground cable.
No. of connection / equipment	-	2
Lightning Protection System		
Vertical / Horizontal Air termination, Down conductor		Copper Flat

**design data - C (earthing & lighting protection
system)**

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.10
				Sheet No. 4

8.10.6 Technical Data by the Tenderer

SECTION : EARTHING & LIGHTNING PROTECTION

8.10.6.1 Earthing System

Earth mat

* Material

Size of conductor

mm²

Fault withstand current & duration

kA, Sec.

Soil resistivity

Ohm metre

Mesh width

m x m

Total length of conductor

m

Earth resistance

Ohm

Permissible touch voltage

V

Permissible step voltage

V

Actual touch voltage

V

Actual step voltage

V

Equipment earthing

* Material

* Size of conductor

mm²

Thickness of galvanising

Earth electrode

* Material

* Size

mm²

Length

m


8.10.6.2 Lightning Protection System


Material and size of horizontal air termination


mm


Material & size of vertical air termination


Quality Plan for cables


		STANDARD QUALITY PLAN		CUSTOMER :			PROJECT:		SPECIFICATION			
				BIDDER/ VENDOR :			QUALITY PLAN		NUMBER :			
		SHEET 1 OF 5		SYSTEM			NUMBER PED-507-00-Q-001, REV-05		SPECIFICATION : TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY VOLUME III			
									P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIALS											
1.1	XLPE Compound	1. Physical properties	MA	Physical Tests	Sample/ Lot	IS:7098 & Mfrs Std./ Appd Data Sheet	IS:7098 & Mfrs Std, Appd Data Sheet	Test Report Log Book	3/2	-	1,2	Raw material verification as per approved sub-vendor list
		2. Elec.Properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	1,2	
1.2	Semi Conducting Compound	1. Phy.and Elec. Properties	MA	Phy.and Elec. Tests	-do-	Manufacturer's standard	Manufacturer's standard	-do-	3/2	-	1,2	
1.3	Copper Foil	1. Dimensions	MA	Measurement	-do-	Manufacturer's std./ Appd. Data sheet	Manufacturer's std./ Appd. Data sheet	Log Book	2	-	1,2	
		2. Physical, Chemical & Elect. Properties	MA	Phy., Chem. & Elect. Tests	-do-	IS:1897	IS:1897	Supplier's test report & log book	3/2	-	1,2	
1.4	PVC Compound (for sheath)	1. Physical properties	MA	Physical Tests	Sample/ lot	IS:5831/BHEL Specification	IS:5831/BHEL Specification	Log Book/ Test Report	3/2	-	1,2	
		2. FRLS Properties	MA	Envir/ Chemical	Sample/ lot	ASTMD-2863, ASTMD-2843, IEC-754-1	Appd. Data sheet	Log Book/ Test Report	3/2	-	1,2	
1.5	Galvanised steel wire/strip	1. Phy. and Elec. Properties	MA	Physical & Electrical Tests	Sample from each batch/ lot	IS:3975/ BHEL Specification/ Appd Data Sheet	IS:3975/ BHEL Specification/ Appd Data Sheet	Log Book/ Test Cert.	3/2	-	1,2	
		2. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	1,2	
		3. Galvanization	MA	Galv. requirement	-do-	-do-	-do-	-do-	3/2	-	1,2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


		STANDARD QUALITY PLAN SHEET 2 OF 5		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ :			QUALITY PLAN NUMBER PED-507-00-Q-001, REV-05			SPECIFICATION : TITLE			
				SYSTEM			ITEM XLPE Power Cables			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
1.6	Copper/Aluminium Rods/Wires	1. Physical Properties	MA	Physical Tests	-do-	IS:613, IS-5484, IS:8130 & BHEL Specification	IS:613, IS-5484, IS:8130 & BHEL Specification	-do-	3/2	-	1,2		
		2. Chemical Composition & purity	MA	Chemical analysis	-do-	-do-	-do-	-do-	3/2	-	1,2		
		3. Electrical properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	1,2		
		4. Dimensions	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	1,2		
2.0	IN PROCESS												
2.1	Wire Drawing	1. Physical, Electrical, Finish & dimension	CR	Phy. & Elect. Tests Visual / Meas.	Sample	IS:8130 & BHEL Specn.	IS:8130 & BHEL Specn.	Log Book	2	-	1		
2.2	Stranding of wires	1. No. of wires	MA	Counting	-do-	BHEL Specn, Apprd. Data Sheet & Relevant IS	BHEL Specn, Apprd. Data Sheet & Relevant IS	-do-	2	-	-		
		2. Sequence, lay length & Direction	MA	Visual, Meas.	-do-	-do-	-do-	-do-	2	-	-		
		3 Surface Finish	MA	Visual	-do-	-do-	-do-	-do-	2	-	-		
		4. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-		
2.3	Conductor Screening	1. Radial thickness	MA	-do-	Sample	BHEL Specn & Apprd. Data Sheet	BHEL Specn & Apprd. Data Sheet	Log Book	2	-	-		N.A. for LT XLPE cables
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				


		STANDARD QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-507-00-Q-001, REV-05			SPECIFICATION : TITLE		
		SHEET 3 OF 5		SYSTEM			ITEM XLPE Power Cables			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	Core Insulation (XLPE) (No repair permitted)	1. Surface finish 2. Concentricity # 3. Thickness of Insulation 4 Dia over insulation 5. Test on XLPE (Tensile & Elongation, Hot Set & Ageing Test) 6. Spark test or water immersion test (applicable for LT XLPE cables only)	MA CR CR MA MA CR	Visual Measurement Measurement Measurement Tests Electrical	100% Sample -do- -do- -do- 100%	- Mfr's Std./Appd. data sheet BHEL specn./Apprd. Data Sheet/ IS:7098 -do- -do- Mnfr's Std	-do- Mfr's Std./Appd. data sheet BHEL specn./Apprd. Data Sheet/ IS:7098 -do- -do- Mnfr's Std	Log Book Log Book Inspection Report -do- -do- Log Book	2 2 2 2 2 2	- - - - - -	1 1 - - 1 1	# To be checked at starting & finish end of Extruded Length
2.5	Insulation Screening, (Non Metallic & Metallic)	1. Surface finish 2. Thickness 3 Overlap of Tape Band 4 Tightness of Tape Band	MA MA MA MA	Visual -do- Measurement Visual	Sample -do- -do- -do-	- BHEL Spec./ data sheet BHEL Spec./ data sheet Plant Std.	Free from bulging burnt particles lumps, cuts & Scratches. BHEL Spec./ data sheet BHEL Spec./ data sheet Plant Std.	Log Book -do- -do- -do-	2 2 2 2	- - - -	- - - -	N.A. for LT XLPE cables
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


		STANDARD QUALITY PLAN SHEET 4 OF 5		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ :			QUALITY PLAN			SPECIFICATION :		
				VENDOR			NUMBER PED-507-00-Q-001, REV-05			TITLE		
SYSTEM				ITEM XLPE Power Cables			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	
2.6	Core Laying	1. Dia over laid up core	MA	Measurement	Sample	Apprd. Data Sheet	Apprd. Data Sheet	Log Book	2	-	-	
		2. Sequence of lay, & direction	MA	Visual & Meas.	Sample	IS 7098/ Mfrs.Std.	IS 7098/ Mfrs.Std.	-do-	2	-	-	
		3. Lay Length	MA	Meas.	-do-	Mnfrs. Std.	Mnfrs. Std.	-do-	2	-	-	
2.7	InnerSheath Extrusion	1. Surface finish	MA	Visual	100%	--	Free from bulging, burnt particles, lumps cuts & scratches.	-do-	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	Appd. Data Sheet, IS:7098	Appd. Data Sheet, IS:7098	-do-	2	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
2.8	Armour	1. No.of wires/Strips	MA	Counting	At the start of the process	BHEL Specn./ Apprd.Data sheet	BHEL Specn./ Apprd.Data sheet	-do-	2	-	-	
		2. Lay Direction	MA	Visual	-do-	IS:7098	IS:7098	-do-	2	-	-	
		3. Lay Length	MA	Meas.	-do-	Plant Standard	Plant Standard	Log Book	2	-	-	
		4. Coverage	MA	Measurement	-do-	BHEL Specn./ Appd. Data Sheet	BHEL Specn./ Appd. Data Sheet	-do-	2	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.9	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	-	Free from Porosity, Bulging, burnt particles, lumps, cuts &	Log Book	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	Appd. Data Sheet	Appd. Data Sheet	Log Book	2	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
		4. Marking	MA	Visual	100%	IS:7098, BHEL Specn & Appd. Data Sheet	IS:7098, BHEL Specn. & Appd. Data Sheet	Test Report	2	-	-	Sequential marking shall be done by printing
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDORS COMPANY SEAL												

		STANDARD QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-507-00-Q-001, REV-05			SPECIFICATION : TITLE		
		SHEET 5 OF 5		SYSTEM			ITEM XLPE Power Cables			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.10	Finished Cable (INTERNAL)	1. Routine Test	CR	Elec. & Meas.	100%	IS:7098 & BHEL spec	IS:7098 & BHEL specn.	Test Report	2	-	1	FOR HT: Type tests to be conducted on one drum/size & voltage grade/lot FOR LT: Type tests to be conducted on one drum/size/lot
		2. Type Tests (internal)	CR	Physical & Electrical Tests	Sample	Approved Type & acceptance test schedule	Approved Type & acceptance test schedule & approved Data Sheet	-do-	2	1		
3.0	Final Inspection (EXTERNAL)	1. Finish & Length	MA	Visual, Measurement	(See remark)	BHEL specn. & IS:7098	BHEL Specn./ Free from Porosity, Bulging Burnt particles, lumps, cuts & scratches	-do-	2	1	-	
		2. Dimension	MA	Measurement	As per IS	Appd.Data Sheet/ IS:7098, IS:10810	Specn./ Appd. Data Sheet/ IS:7098, IS:10810	-do-	2	1	-	
		3. Armouring - Coverage No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	-do-	-do-	2	1	-	
		4. Marking & Colour Coding	MA	Visual	-do-	-do-	-do-	-do-	2	1	-	
		5. Acceptance Tests	CR	Phy, Elect. Tests FRLS Tests	-do-	Appd Data Sheet/ IS: 7098	Appd Data Sheet/ IS: 7098	-do-	2	1		
		6. Type Tests	CR	Physical & Electrical Tests	Sample *	Approved Type & acceptance test schedule	Approved Type & acceptance test schedule & approved Data Sheet	-do-	2	1		1. * FOR HT: Type tests to be conducted on one size of each voltage grade/lot except FRLS (outer sheath) tests & Electrical tests which shall be conducted on every size & voltage grade of cables. 2. * FOR LT: Type tests to be conducted on one size (sample)/lot per Type (CU/ AL conductor) 3. *Flammability test as per IEC 332, Part-3 CAT-B to be conducted on one sample only/lot
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION, VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER VENDOR'S SPECIFICATION (D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET (F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER SAMPLING PLAN AGREED BY PURCHASER. (G) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION. LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL 2-VENDOR 3- SUB VENDOR CHP:CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE												
		BHEL	PARTICULARS			BIDDER/ VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-507-00-Q-002, REV.03			SPECIFICATION TITLE		
		SHEET 1 OF 5		SYSTEM			ITEM :PVC POWER & CONTROL CABLE			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL											
1.1	PVC Compound(for insulation and sheath)	1. Physical properties	MA	Physical Tests	Sample	IS-5831/BHEL Specification	IS-5831/BHEL Specification/appd data sheet	Log Book/ Test Cert.	3/2	-	2,1	* Sample from each Batch/Lot.
		2. Elec.Properties	MA	Electrical Tests	Sample	-do-	-do-	-do-	3/2	-	2,1	
		3. Make & Type	MA	Visual	100%	Plant Std.	Plant Std.	-do-	2	-	-	
1.2	Galvanised steel wire/strip	1. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	IS-3975 BHEL Specification	IS-3975/BHEL Specification/appd data sheet	-do-	3/2	-	2,1	
		2. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2,1	
		3.Galvanization Quality	MA	Galv.Tests	-do-	-do-	-do-	-do-	3/2	-	2,1	
1.3	Copper/Aluminium Rods/ Wires	1. Physical Properties	MA	Physical Tests	-do-	IS-613 IS-5484 IS-8130 AND BHEL Specification	IS-613 IS-5484 IS-8130 AND BHEL Specification	-do-	3/2	-	2,1	
		2. Chemical Composition & purity	MA	Chemical analysis	-do-	-do-	-do-	-do-	3/2	-	2,1	
		3.Electrical properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	2,1	
		4.Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2,1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


		QUALITY PLAN SHEET 2 OF 5		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		ITEM :PVC POWER & CONTROL CABLE			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	Wire Drawing , Tinning and Annealing	1. Physical, Electr. Finish & dimension	CR	Phy.&Elect. Tests Visual & Meas.	Sample	BHEL Specn. IS-8130	BHEL Specn. IS-8130	Log Book	2	-	1	
		2. Chemical test for Tinning (if applicable)	CR	Chemical Test	Sample	-do-	-do-	-do-	2	-	-	
2.2	Stranding of wires	1. No.of wires	MA	Counting	Sample	Vendors/BHEL Specn. & Apprd. Data Sheet & Relevant IS	Vendors/BHEL Specn. & Apprd. Data Sheet & Relevant IS	-do-	2	-	-	
		2. Sequence, lay length & Direction	MA	Visual, Meas	Sample	-do-	-do-	-do-	2	-	-	
		3 Surface Finish	MA	Visual	Sample	-do-	-do-	-do-	2	-	-	
		4.Dimension	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
2.3	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	-	Free from bulging burnt particles lumps, cuts & Scratches.	-do-	2	-	1	
		2 Insulation thickness	CR	Measurement	Sample	Appd.data sheet IS-1554	Appd.data sheet IS-1554	-do-	2	-	-	
			PARTICULARS		BIDDER/VENDOR							
BHEL			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				


		QUALITY PLAN SHEET 3 OF 5		CUSTOMER :		PROJECT			SPECIFICATION :				
				BIDDER/ :		TITLE			NUMBER :				
				VENDOR		QUALITY PLAN			SPECIFICATION :				
		SYSTEM		ITEM :PVC POWER & CONTROL CABLE			TITLE			SECTION			
					VOLUME III								
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	P	W	V	11	
2.4	Core Laying	3. Concentricity #	CR	Measurement	Sample	Mfr's Std./Appd. data sheet	Mfr's Std./Appd. data sheet	Log Book	2	-	1	# To be checked at starting & finish end of Extruded Length	
		4 Dia over insulation	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-		
		5. Spark Test or Water Immersion test	CR	Electrical	100%	Mfr's Std.	Mfr's Std.	-do-	2	-	1		
		6. Core identification	MA	Visual	100%	IS-1554	IS-1554	-do-	2	-	-		
		1. Dia over laidup core	MA	Measurement	Sample	-do-	-do-	Log Book	2	-	-		
2.5	InnerSheath Extrusion (If applicable)	2.Sequence of lay, Lay length & direction for laid up core	MA	Visual & Meas.	Sample	Mfrs.Std./relevant IS	Mfrs.Std./relevant IS	-do-	2	-	-		
		1. Surface finish	MA	Visual	100%	--	Free from bulging, burnt particles, lumps cuts & scratches.	-do-	2	-	-		
		2. Sheath thickness	MA	Measurement	Sample	IS-5831, IS-1554 data sheet	IS-5831, IS-1554 data sheet	-do-	2	-	-		
		3.Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-		
2.6	Armouring (If applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	-do-	2	-	-		
		2. Lay Direction	MA	Visual	-do-	-do-	-do-	-do-	2	-	-		
			PARTICULARS		BIDDER/VENDOR								
BHEL			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					


		QUALITY PLAN SHEET 4 OF 5		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ :			QUALITY PLAN			SPECIFICATION :		
				VENDOR			NUMBER PED-507-00-Q-002, REV.03			TITLE		
		SYSTEM			ITEM :PVC POWER & CONTROL CABLE			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	Outer Sheath Extrusion	3. Lay Length	MA	Visual, Meas.	At the start of the process	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	Log Book	2	-	-	
		4. Coverage	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		1. Surface Finish	MA	Visual	100%	-	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Log Book	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	IS-5831 & IS-1554 Data Sheet	IS-5831 & IS-1554 Data Sheet	Log Book	2	-	-	
		3. Dia over outer sheath	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
		4. Marking	MA	Visual	100%	IS-1554 & BHEL Specn.	IS-1554 & BHEL Specn.	Test Report	2	-	-	
2.8	Finished Cable	1. Routine Test	CR	Elec. & Meas.	100%	IS-1554 & BHEL Specn	IS-1554 & BHEL Specn	Test Report	2	-	1	Sequential marking shall be done by printing
		2. Type & FRLS Tests	CR	Elec., Phy & Meas.	One Drum per size per Lot	-do-/Apprd.data sheet	-do-/Apprd.data sheet	Test Report	2	-	1	Vendor's internal testing
3.0	Final Inspection	1. Finish & Length	MA	Visual	(See remark)	BHEL specn. IS-1554	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Test Report	2	1	-	One drum each for Power & control cables in a Lot
BHEL			PARTICULARS			BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL			
			NAME									
			SIGNATURE									
			DATE									


		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-507-00-Q-002, REV.03			SPECIFICATION : TITLE		
		SHEET 5 OF 5		SYSTEM			ITEM :PVC POWER & CONTROL CABLE			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		2. Dimension 3. Armouring - Coverage No.of Wires/Strips 4. Marking/Colour Coding 5. Acceptance Tests 6. Type & FRLS Tests	MA	Measurement	As per IS	Appd.Data Sheet/ IS-1554 & IS-10810	Appd.Data Sheet/ IS-1554 & IS-10810	Test Report	2	1	-	Type Test shall be witnessed on one size (sample) of every lot for control cable. Type Test shall be witnessed on one size (sample) per type (CU/AL conductor) of every lot for Power cable.
			MA	Visual & Meas.	As per IS	-do-	-do-	-do-	2	1	-	
			MA	Visual	-do-	-do-	-do-	-do-	2	1	-	
			CR	Phy & Elect. Tests FRLS Tests	As per IS	-do-	-do-	-do-	2	1	-	
			CR	Measurement	(SEE REMARK)	BHEL Specn. Apprd.Data Sheet	BHEL Specn. Apprd.Data Sheet	-do-	2	1	-	
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER VENDOR'S SPECIFICATION. (D) PURCHASER SHALL HAVE RIGHT TO WITNESS THE SPARK TEST AT CORE STAGE (E) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (F) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET (G) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS 'SAMPLE' & NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN. (H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER IS/ BHEL SPECIFICATION. LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL 2-VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE.												
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDORS COMPANY SEAL												

		QUALITY PLAN SHEET 1 OF 5		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ VENDOR			TITLE			NUMBER :		
				SYSTEM			QUALITY PLAN NUMBER PED-507-00-Q-004, REV.02			SPECIFICATION TITLE		
			ITEM :INSTRUMENTATION CABLES			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL											
1.1	PVC Compound(for insulation and sheath)	1. Physical properties	MA	Physical Tests	Sample	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Log Book/ Test Cert.	3/2	-	2	
		2. Elec.Properties (insulation)	MA	Electrical Tests	Sample	-do-	-do-	-do-	3/2	-	2	
		3. FRLS Properties (outer sheath)	CR	Environmental	Sample	-do-	-do-	-do-	3/2	-	2	
1.2	Galvanised steel wire/strip	1. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	-do-	3/2	-	2	* Sample from each Batch/Lot as per IS-3975 Annexure-A
		2. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2	
		3.Galvanization Quality	MA	Galv.Tests	-do-	-do-	-do-	-do-	3/2	-	2	
1.3	Copper Rods/ Wires (For conductor/ drain wire)	1. Physical Properties	MA	Physical Tests	-do-	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	-do-	3/2	-	2	
		2.Electrical properties	CR	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	2	
1.4	Fillers	1. FRLS Properties	CR	Chemical/ Environ. test	-do-	-do-	-do-	-do-	3/2	-	2	
1.5	Screen	1. Dimension	MA	Measurement	-do-	Appd. Data Sheet	Appd. Data Sheet	TC & IR	3/2	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 2 OF 5	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :				
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-507-00-Q-004, REV.02			SPECIFICATION : TITLE				
			SYSTEM			ITEM :INSTRUMENTATION CABLES			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.0	IN PROCESS	2.. Mech. Prop.	MA	Mech test	-do-	MFRS. STD.	MFRS. STD.	TC & IR	3/2	-	2		(Applicable only for tin-coated copper conductor and drain wire)
2.1	Wire Drawing , Tinning and Annealing	1. Physical, Electrical, surface finish & dimension	CR	Phy.&Elect. Tests Visual & Meas.	Sample	Relevant Std./ BHEL Specn.	Relevant Std./ BHEL Specn.	Log Book	2	-	1		
		2. Chemical test for Tinning	CR	Chemical Test (Persulphate test)	Sample	-do-	-do-	-do-	2	-	-		
2.2	Stranding of wires	1. No.of wires	MA	Counting	Sample	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	-do-	2	-	-		
		2. Sequence, lay length & Direction	MA	Visual, Meas	Sample	Relevant Standard/ Vendor's Spec.	Relevant Standard/ Vendor's Spec.	-do-	2	-	-		
		3 Surface Finish	MA	Visual	Sample	-do-	-do-	-do-	2	-	-		
		4.Dimension	MA	Measurement	Sample	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	-do-	2	-	-		
2.3	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	-	Free from bulging burnt particles lumps, cuts & Scratches.	-do-	2	-	1		
		2 Insulation thickness	CR	Measurement	Sample	Appd.data sheet/ Relevant Std.	Appd.data sheet/ Relevant Std.	-do-	2	-	-		
			PARTICULARS			BIDDER/VENDOR							
BHEL			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 3 OF 5		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :				
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-507-00-Q-004, REV.02			SPECIFICATION : TITLE				
				SYSTEM		ITEM :INSTRUMENTATION CABLES			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	Core pairing, screening (provision of drain wire & laying)	3. Concentricity #	CR	Measurement	Sample	Mfr's Std./Appd. data sheet	Mfr's Std./Appd. data sheet	Log Book	2	-	1	# To be checked at starting & finish end of Extruded Length	
		4 Dia over insulation	MA	Measurement	Sample	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	-do-	2	-	-		
		5. Spark Test or Water Immersion test	CR	Electrical	100%	Mfr's Std.	Mfr's Std.	-do-	2	-	1		
		6. Core identification	MA	Visual	100%	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	Relevant Standard/ Appd. Data Sheet/ BHEL Specification	-do-	2	-	-		
		1. Pair identification	MA	Visual	100%	BHEL Spec. & appd. Data sheet	BHEL Spec. & appd. Data sheet	Log Book	2	-	-		
		2.Wire size & tape size	MA	Measurement	100%	-do-	-do-	-do-	2	-	-		
		3.Test for capacitance	CR	Elect. Test	100%	-do-	-do-	-do-	2	-	1		
		4. Sequence of lay and lay length	MA	Visual meas	Sample	BHEL Spec. & MFRs. Std.	BHEL Spec. & MFRs. Std.	-do-	2	-	-		
		5. Screen overlap & coverage	MA	Measurement	Sample	BHEL Spec.	BHEL Spec.	-do-	2	-	-		
		6. Dia over laid up core	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-		
2.5	InnerSheath Extrusion	7. Continuity of drain & drain wire with Screen	MA	Elect. Test	100%	<-----No Discontinuity ----->		-do-	2	-	-	(Applicable for armoured cables)	
		1. Surface finish	MA	Visual	100%	--	Free from bulging, burnt particles, lumps cuts & scratches.	-do-	2	-	-		
		2. Sheath thickness	MA	Measurement	Sample	BHEL Spec. & appd. Data sheet	BHEL Spec. & appd. Data sheet	-do-	2	-	-		
			PARTICULARS		BIDDER/VENDOR								
BHEL			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN SHEET 4 OF 5	CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER/ VENDOR :			TITLE			NUMBER :			
			SYSTEM			QUALITY PLAN NUMBER PED-507-00-Q-004, REV.02			SPECIFICATION : TITLE			
			ITEM :INSTRUMENTATION CABLES			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.6	Armouring	3.Dia over inner sheath	MA	Measurement	Sample	BHEL Spec. & appd. Data sheet	BHEL Spec. & appd. Data sheet	-do-	2	-	-	
		1. No.of wires/Strips	MA	Counting	At the start of the process	BHEL Specn./ Appd. Data sheet	BHEL Specn./ Appd. Data sheet	-do-	2	-	-	
		2. Lay Direction	MA	Visual	-do-	-do-	-do-	-do-	2	-	-	
		3. Lay Length	MA	Visual, Meas.	At the start of the process	Rel. Std./ BHEL Specn./Appd. Data sheet	Rel. Std./ BHEL Specn./Appd. Data sheet	Log Book	2	-	-	
		4. Coverage	MA	Measurement	-do-	BHEL Specn./Appd. Data sheet	BHEL Specn./Appd. Data sheet	-do-	2	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.7	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	-	Free from Bulging Burnt particles, lumps, cuts & scratches	Log Book	2	-	-	
		2.Sheath thickness	MA	Measurement	Sample	BHEL Specn./Appd. Data sheet	BHEL Specn./Appd. Data sheet	Log Book	2	-	-	
		3. Dia over outer sheath	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
		4. Marking	MA	Visual	100%	BHEL Specn./Appd. Data sheet	BHEL Specn./Appd. Data sheet	Test Report	2	-	-	Sequential marking shall be done by printing
2.8	Finished Cable	1. Routine Test	CR	Elec. & Meas.	100%	BHEL Specn./Appd. Data sheet	BHEL Specn./Appd. Data sheet	Test Report	2	-	1	
		2. Type & FRLS Tests	CR	Elec., Phy & Meas	Sample *	BHEL Specn./Appd. Data sheet	BHEL Specn./Appd. Data sheet	Test Report	2	-	1	* One Drum/Size/Lot
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 5 OF 5		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ VENDOR :			TITLE			NUMBER :		
				SYSTEM			QUALITY PLAN NUMBER PED-507-00-Q-004, REV.02			SPECIFICATION : TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	Final Inspection	1. Finish & Length 2. Dimensions 3. Armouring - Coverage No.of Wires/Strips 4. Marking/Colour/ pair identification 5. Test for screening 6. Acceptance Tests 7. Type & FRLS Tests	MA	Visual	(See remark)	BHEL specn./ Relevant Std	Free from Bulging Burnt particles, lumps,porosity, cuts & scratches	Test Report	2	1	-	One drum in a Lot
			MA	Measurement	Sample Lengths	BHEL Specn./Appd. Data sheet	BHEL Specn./Appd. Data sheet/ test procedures	Test Report	2	1	-	
			MA	Visual & Meas.	Sample	-do-	-do-	-do-	2	1	-	
			MA	Visual	-do-	-do-	-do-	-do-	2	1	-	
			CR	Elect. Test	-do-	test procedures/	test procedures	-do-	2	1	-	
			CR	Phy & Elect. Tests	As per IS @	-do-	-do-	-do-	2	1	-	@: As per IS 1554 part-1 except flammability test which shall be performed on one sample only.
			CR	Measurement	Sample#	BHEL Specn./Appd. Data sheet/ appd. TTP	BHEL Specn./Appd. Data sheet/ appd. TTP	-do-	2	1	-	#1.Physical/ Electrical/ Mechanical/ standard technical parameters: One size of each type[INDI.& OVERALL/ OVERALL] per lot. 2. Flammability tests: one sample only.
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY REL STD / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER REL. STD./ BHEL SPECIFICATION (D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION (F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER (H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER REL. STD./ BHEL SPECIFICATION. (I) TICK APPLICABLE STANDARD W.R.T TO CONTRACTUAL REQUIREMENTS VDE/IS /IEC.												
LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3 SUB VENDOR CHP: CUSTOMER HOLD POINT												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

Load data format (Electrical)

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (AC) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (DC): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)



LOAD DATA (ELECTRICAL)

JOB NO.	ORIGINATING AGENCY		PEM (MAUX)	
PROJECT TITLE	MARIB 400MW GTPS, PH-II	NAME	DATA FILLED UP ON	
SYSTEM	DOUBLE GIRDER EOT CRANES	SIGN.	DATA ENTERED ON	
DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE
				67 of 67

**Technical Specifications, Quality plan and
Data Sheet for
Local Control Panel**



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 1 OF 9

1. SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the Manufacturers works, proper packing for transportation and delivery to Mumbai port CHA Godown of the Local Panels required for control and monitoring of the Auxiliary plant & Equipment.

2. CODES AND STANDARDS

2.1 All equipment specified herein shall comply with the requirements of the latest issue of the National and International Standards.

2.2 As minimum requirements the panels shall comply with the following Indian Standards.

- a) IS-6005:1970 - Code of Practice for Phosphating of iron and steel
- b) IS-5:1978 - Colours for ready mixed paints & enamels.
- c) IS-1248:1983 - Direct Acting Indicating Instruments.
- d) IS-13947 (Part-III):1993 - Rotary Cam Switches.
- e) IS-6875:1973 - Auxiliary relays.
- f) IS-8828:1993 - Circuit breaker for household and similar installations.
- g) IS-13947 (Part-I):1993 - Low Voltage switchgear & control gear: Part-I (General Rules)
- h) NFPA-196:1974 - Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the instruments, annunciation system, Programmable Logic Controller (PLC). Single loop controller, Control switches/push buttons, indicating lamps, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 2 OF 9

- 3.1.3** The panel shall be suitably reinforced adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth. The panels shall be mounted on a channel base frame via suitable anti-vibration mountings.
- 3.1.4** The material of the sheet steel for front, top, bottom and doors shall be Cold Rolled Cold Annealed (CRCA). The sheet thickness shall be 2.5 mm for front sheet and 2.0 mm for top & side of the panel. The panel's shape and size shall be required for mounting operation and maintenance of the specified equipment on the panel. However, its height shall be 2365 mm including the height of the base frame, pedestal and anti-vibration mounting. In case of skid mounted panels, its total height including the height of the skid not exceeds 2365 mm.
- 3.1.5** The panel shall be provided with rear doors with integral key lockable handle. The door when locked shall be held at minimum three places. The doors shall be minimum 1.6 mm thick, not more than 550 mm wide and be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door should be capable of being opened through a maximum of 90 deg. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings/documents.
- 3.1.6** Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation louvers shall be provided at bottom and top of the doors covered with removable wire mesh.
- 3.1.7** The class of protection shall be in accordance with IP-54 unless otherwise specified in the data sheet-A (No. PES-145-54A-DSI-0).
- 3.1.8** All steel surfaces shall be cleaned by sand/pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panels shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy/synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145-54A-DSI-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9** The Panel shall be supplied complete with foundation bolts, anchoring fasteners, base channel, anti-vibration mountings, pedestals, removable lifting eye bolts and undrilled gland plate etc.
- 3.1.10** The undrilled cable gland plates of minimum 3 mm sheet thickness shall be mounted at panel bottom. The cable glands of the required size and type as given in data sheet-A (No. PES-145-54A-DSI-0) shall be supplied along with the Panel.
- 3.1.11** Instruments, alarm annunciator, PLC, operable and indicating devices, relays, timers, MCBs etc. shall be provided as per the approved scheme. Necessary temperature scanners for monitoring HT motor winding & bearing temp. It shall be housed in the panel. All



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 3 OF 9

valve position feedback indication (Pneumatic / Motor operated valves) shall be displayed in the panel.

- 3.1.12** All operable and indicating devices shall be mounted on the front of the panel while aux. Relays/timers MCBs required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.

No operable or indicating device shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation/maintenance. This is also applicable for mounting of aux. Relays timer4s MCB's etc.

- 3.1.13** Single/dual control power supply feeders of voltage class as specified in the data sheet as given in data sheet-A (No. PES-145-54A-DSI-0) shall be provided by BHEL. Where DC control power supply is specified an additional 240V AC supply feeder for powering of space heater and lighting shall be provided by BHEL. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any power supply required for the operation of the devices mounted in the panel shall be arrangement by the vendor.

- 3.1.14** The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire/flexible of 1.5 mm² size. In case of PLC based systems, size & grade of internal wiring shall be decided by the purchaser on the basis of manufacturers recommendation. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme/wiring diagram. Wires shall be routed and run through PVC troughs.

- 3.1.15** Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5 mm² external cables. The terminals for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminals shall be not be mounted below 250 mm. The panel shall have twenty (20) percent spare terminals.

- 3.1.16** The interior of each panel shall be suitably illuminated through fluorescent lamps operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp., 3-pin Power receptacle shall be provided. The panel shall also be provided with a Telephone Jack of 6.3 mm size.

- 3.1.17** Suitable heaters operable on 240 volts 50 Hz AC power system shall be provided at the panel bottom. It shall be so designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 4 OF 9

control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.18 The panel shall be provided with a copper earth bus of 25x3 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to main station earth. The panel-mounted equipments/devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.

3.1.19 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual instruments/devices on the panels shall be as provided with separate nameplate with inscription of 3 mm height. The instrument/devices shall be provided stick on labels inside the panel by indelible ink. The material of the main and individual labels shall be 2 mm Anodized Aluminum Plate. The inscription shall be with white letters on black background.. The labels shall be fixed by self-tapping non-rusting screws.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-196 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurization falls down 2.5 mm of water column. Protection shall be of type Z of NFPA-196. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-196. Vendor must provide a protective device on the panel to protect the panel from over pressurization.

3.2.2 Vendor shall supply pressurization kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rota meter etc. pressurization kit shall be surface mounting on a metal board and located outside the local panel. Pressurization kit shall further consist of solenoid valves flow switch, timer, blow off safety device etc., so as to make purging fully automatic. However, final start shall be manual. Panel protection against over pressure to be provided as per NFPA-196.

3.2.3 Pressurized local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-196.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc. which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc., requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurization bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painting metallic parts shall be of stainless steel material.



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 5 OF 9

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits/components which are powered from motor control center or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring Devices

3.3.1 Instruments like indicators, recorders, single loop controllers PLC etc. as applicable are specified elsewhere for the plant/equipment shall be supplied and mounted on the panel.

3.4 Alarm Annunciator System:

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) per cent spare windows or minimum two (2) windows along with electronics.

3.5 Relays:

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.6 Timers:

The timers shall be electronic or electro pneumatic type suitable for specified control supply. Its contact configuration and ratings shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.7 Control/Selector Switches:

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position/function.

3.8 Push Buttons/indicating Lights:

The push buttons shall be momentary action self resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate/inscription plate. Colour coding of push buttons shall be as under:



Technical specification for Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 6 OF 9

RED Motor OFF/Valve CLOSE YELLOW Alarm acknowledge

GREEN Motor ON/Valve OPEN BLACK Lamp test

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with 7W/10W filament type lamp replaceable from front and giving good visibility from front. Colour coding of lights shall be :

GREEN Motor OFF/Valve CLOSED AMBER Motor TRIPPED
condition condition

RED Motor ON/Valve OPEN WHITE Normal/healthy
condition condition.

3.9 Ammeters:

Ammeters shall be 96 x 96 mm size, 90 deg deflection, 1.5% accuracy, 1 Amp. CT operated and Flush mounting type Ammeters for motors shall have six (6) times folded scale at upper end enable motor starting current indication.

3.10 Miniature Circuit Breaker (MCB):

These shall be of instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal feature for over current protection. The housing of MCB shall be made of non-ignitable high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.11 Makes of various instruments/devices shall be as given below:

1. Alarm Annunciators : Procon / IIC
2. Ammeters : AEP / IMP / L&T
3. Control/Selector Switches : GEC Alsthom / Kaycee / Siemens / L&T
4. Push Buttons/Indicating Lamps : Siemens/L&T/Teknic /GEC Alsthom
5. Auxiliary Relays : Jyoti/Siemens/L&T/OEN
6. Timers : L&T/GEC Alsthom/Bhartiya Cutler Hammer
7. MCBs : S&S Power Engg/Indo Asian/MDS/Havells/L&T
8. Terminal Blocks : Connectweli/Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt Quality Assurance Programme to ensure that the equipment offered will meet the specification requirement in full.



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 7 OF 9

4.2 The vendor shall conduct the following tests as a minimum requirement:

4.2.1 Routine Tests :

1. High Voltage Test
2. I.R. Test
3. Functional Test

4.2.2 Type Tests

1. Enclosure Class Test

4.3 Inspection will be conducted by BHEL and/or their Customer as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests inspections will be deemed to have been included in the bid. For all the items. "Type Test Certificates" for Enclosure Class Test as per agreed Quality Plan for similar/Panel shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or Customer or in Government Test House/ Government approved Test House.

4.4 Test Certificate for Routine tests carried out by the Manufacturer shall be sent to the Purchaser before the request for inspection by BHEL or his authorized representative.

5.0 SPARES AND CONSUMABLES

5.1 The bidder shall include the commissioning spares & consumables required during commissioning.

6.0 DRAWING AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with bid:

1. Data sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plans.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract.

1. Data Sheet No. PES-145A-DS2-0
2. GA Drg indicating layout of instruments, construction details, foundation details,



Technical specification for
Local Control Panel

SPECIFICATION NO.

VOLUME

SECTION

REV. NO. 00

DATE:

SHEET 8 OF 9

cable gland plate alongwith cable glands and all details mentioned in this specification including BOM .

3. Panel Wiring Diagram alongwith grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. 'As Built' Drawing.
7. Relay logic scheme / PLC logic diagram
8. All the drawings/ Documents shall be furnished to DVC by BHEL for approval / information as the case may be.

All the drawings/ Documents shall be furnished to DVC by BHEL for approval / information as the case may be.

7.0 PACKING:

Sea worthy capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing. Equivalent or better packing methods may be deployed subject to approval of the BHEL. Vendor shall submit the packing procedure for its equivalent for BHEL's approval during detailed engineering.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE:

SHEET 1 OF 2

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet A & B

 DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)

 DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER			
	CONSTRUCTION	<input checked="" type="checkbox"/> FOLDED <input type="checkbox"/> WELDED (As per requirement)		
TECHNICAL	INPUT POWER SUPPLY	<input type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC <input type="checkbox"/> 415V 3 PHASE (4 wires)		
	NO. OF FEEDERS	<input type="checkbox"/> ONE <input type="checkbox"/> TWO		
	CONTROL SUPPLY	<input type="checkbox"/> 110V AC <input type="checkbox"/> 220V AC <input type="checkbox"/> 220V DC <input type="checkbox"/> (As per requirement)		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)	_____ NOS. (AS REQUIRED)		
	PAINT TYPE	<input type="checkbox"/> EPOXY <input type="checkbox"/> SYNTHETIC ENAMEL <input type="checkbox"/> POWER COATED		
	PANEL COLOUR (EXTERNAL)	<input type="checkbox"/> LIGHT GREY (Shade 631 IS-5) <input type="checkbox"/> OPALINE GREEN (Shade 275) <input type="checkbox"/>		
	FINISH	<input type="checkbox"/> SEMI MAT <input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input checked="" type="checkbox"/> SEMI GLOSSY		
	PANEL COLOUR (INTERNAL)	<input checked="" type="checkbox"/> WHITE <input type="checkbox"/> CREAM <input type="checkbox"/> OFF WHITE		
	FINISH	<input type="checkbox"/> SEMI MAT <input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input checked="" type="checkbox"/> SEMI GLOSSY		
	CLASS OF PROTECTION	<input checked="" type="checkbox"/> IP-54 <input type="checkbox"/> _____		
	CONTROL HARDWARE	<input checked="" type="checkbox"/> RELAY BASED <input type="checkbox"/> PLC As per Requirement		
	FOUNDATION ARRANGEMENT	<input checked="" type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS		
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE	<input type="checkbox"/> PRESSURISED <input type="checkbox"/> UNPRESSURISED As per Requirement		
	CABLE GLAND	<input type="checkbox"/> SINGLE COMPRESSION <input checked="" type="checkbox"/> DOUBLE COMPRESSION		
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME SIGNATURE DATE



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE:

SHEET 1 OF 2


TAG No. Qty.....

Data Sheet No.: **PES-145A-DS1-0**


Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION			
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH			
	PANEL COLOUR (INTERNAL)			
	FINISH			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE			
CABLE GLAND				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME SIGNATURE DATE

<div> PEM :: C&I</div>		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										QUALITY PLAN NO.: PE-QP-999-145-I056				
Sl. No.		Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
										P	W	V				
INCOMING																
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition 2. Bend Test 3. Surface finish 4. Waviness 5. Thickness 6. Mill marking	MA CR MA MA MA MA	Chemical analysis Mech. test Visual Visual Measurement Visual	Sample Sample 100% 100% 100% 100%	IS:1079 IS:513 IS:1079 IS:513 Factory Standard / Sample Factory Standard BHEL Spec. BHEL Spec.	IS:1079 IS:513 IS:1079 IS:513 Factory Standard / Sample No Waviness BHEL Spec. BHEL Spec.	Test Certificate Log Book Log Book Log Book Log Book Log Book	3 2 2 2 2 2	--- --- --- --- --- ---	2 --- --- --- --- 1					
2.0	Flats / Angles / Channels	1. Dimensions 2. Surface Defects 3. Straightness 4. Mill marking	MA MA MA MA	Measurement Visual Measurement Visual	Sample 100% 100% 100%	IS:2062 Factory Standard / Sample Factory Std. IS:2062	IS:2062 Factory Standard / Sample Factory Std. IS:2062	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	--- --- --- 1					
3.0	Cables / Wires	1. Visual / Surface defects 2. IR and HV	MA MA	Visual Electrical	100% 100%	BHEL Spec. and IS:1554 or IS:694 BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694 BHEL Spec. and IS:1554 or IS:694	Log Book Log Book	2 2	--- ---	--- ---					
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics																
\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.																
1 - BHEL 2 - Vendor 3 - Sub-vendor																


STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										QUALITY PLAN NO.: PE-QP-999-145-1056				
										VOLUME IIB				
										SECTION D				
										REV. NO. 01				
										DATE: 18-05-2007				
SHEET 3 OF 7														
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks		
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---			
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI	Measurement	100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book	2	---	---			
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI	Measurement	100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book	2	---	---			
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA	Measurement	100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book	2	---	2			
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics										\$			P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor

<div></div> <div>PEM :: C&I</div>		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										QUALITY PLAN NO.: PE-QP-999-145-1056				
												VOLUME		IIB		
												SECTION		D		
												REV. NO.		DATE: 18-05-2007		
												SHEET		4		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks				
									P	W	V					
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA MA MA MA MA MA	Visual Measurement Measurement Visual Visual, Thickness Visual Visual, Thickness Visual Visual, Thickness, Scratch test Colour adhesion	100% Periodic 100% 100% 100% 100% 100%	Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005	Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005	Log Book Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2 2	--- --- --- --- --- --- --- ---	1 1 1 1 1 1 1 1					
		<div>LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics</div> <div>\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor</div>														


LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

<div></div> <div>PEM :: C&I</div>		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										QUALITY PLAN NO.: PE-QP-999-145-I056				
		VOLUME		IIB												
		SECTION		D												
		REV. NO.		01	DATE: 18-05-2007											
		SHEET		6	OF		7									
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks				
									P	W	V					
		4 Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.				
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1					
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1					
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1					
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1					
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1					
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1					
		11. Wire Termination	MA	Pulling manually	Sample	----	Firm termination	Inspection Report	2	1	1					
		12. Continuity	MA	Electrical	100%	----	Continuity OK	Inspection Report	2	1	1					

LEGEND: * CR - Critical characteristics		\$		P - Agency Performing the Test.		1 - BHEL	
MA - Major characteristics		W		V - Agency Witnessing the Test.		2 - Vendor	
MI - Minor characteristics		V		- Agency Verifying the Test.		3 - Sub-vendor	

<div> PEM :: C&I</div>		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										QUALITY PLAN NO.: PE-QP-999-145-I056								
												VOLUME		IIB						
												SECTION		D						
												REV. NO.		01		DATE: 18-05-2007				
												SHEET		7		OF		7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks								
									P	W	V									
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1									
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1									
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1									
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1									
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1									

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		\$		P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.		1 - BHEL 2 - Vendor 3 - Sub-vendor	
---	--	----	--	--	--	--	--

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC - ME 400 MW MARIB GTPS - II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	Sheet No. 140

For other actuators provision shall be made for later installation of externally mounted limit switches, if required. These Switches shall be housed in robust, dust-and moisture-proof cases and shall be suitable for the ambient conditions local to the equipment on which they are mounted.

17.4.3.0 Local Control Cabinets

These shall be free standing type and fabricated preferably from 2 mm thick cold rolled steel sheet or 3 mm thick hot rolled steel sheet.

The finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filter and two coats of high grade paint.

These shall be of totally enclosed type with removable hinged doors at the side or back for easy maintenance and accessibility of instruments. Adequate illumination and a service socket shall be provided inside each local cabinet. Ingress protections shall be NEMA 4X for local control cabinets.

17.4.4.0 Indicators, Recorders

Indicators

The minimum size for indicators mounted on the various sections of the control desks and panels shall be as per manufacturer's standard.

The minimum accuracy tolerance for the above indicators shall be 1.5% of span.

Panel shall generally be microprocessor based digital indicators having at least 4-digit indications.

Local pressure and temperature indicators mounted on gauge boards shall be of circular type and shall have 150 mm. All local indicators shall be housed in robust dust and moisture proof cases suitable for open air installation.

All instruments mounted in the control rooms shall be rectangular or square type. The exposed metal portions of all cases shall have the same finish, trim and general appearance. Instrument cases shall be dust proof. The glass for indicators, recorders and similar equipment shall be of the non-reflecting, anti-static type and should minimize parallax errors.

Recorders

Flows, pressures and fast changing temperatures shall be recorded on continuous line recorders. Only measurement values subject to slow changes may be recorded on dotted line recorders.

The recorders shall be of microprocessor based, 100mm wide with suitable markings each recorder shall be furnished with chart re-roll, chart tear-off device, internal chart illumination (if locally mounted). Chart speed shall be adjustable. The recorders shall have an integral indicator.

All recorders shall be of fibre pen type.

Where two or more values are recorded by continuous lines on the same chart they shall be distinguished by the use of different and distinctive colours.