

**400 MW MARIB GTPS
PHASE II**

VOLUME - IIB & III

**TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM**

SPECIFICATION NO.: - PE-TS-³⁷²~~367~~-555-A001, REV. - 0,



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



TITLE **400 MW MARIB GTPS PH II**
INDEX
COMPRESSED AIR SYSTEM

SPECIFICATION NO: PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20.07.2012

SHEET 1 OF 1

VOLUME – IIB

| SECTION | TITLE | SPECIFICATION NO. | No. of Sheets. |
|------------|--|--------------------------------|----------------|
| SECTION-A | SCOPE OF ENQUIRY | PE-TS-372-555-A001 | 1 |
| SECTION-B | PROJECT INFORMATION | | 2 |
| SECTION-C1 | SPECIFIC TECHNICAL REQUIREMENT | PE-TS-372-555-A001 | 7 |
| SECTION-C2 | CUSTOMER TECHNICAL SPECIFICATION | | 19 |
| SECTION-C3 | TECHNICAL SPECIFICATION (ELECTRICAL PORTION) | | 67 |
| SECTION-C4 | TECHNICAL SPECIFICATION (C & I PORTION) | | 110 |
| SECTION-C5 | PAINTING SPECIFICATION | | 19 |
| SECTION-C6 | SEAWORTHY PACKING SPECIFICATION | | 61 |
| | <u>ANNEXURES</u> | | |
| ii) | ANNEXURE-I | LIST OF MAKES CODES & STANDARD | 5 |
| i) | ANNEXURE-II | CODES & STANDARD | 3 |
| SECTION-D | STANDARD TECHNICAL SPECIFICATIONS | | 26 |

VOLUME-III

(DATA SHEET AND SCHEDULES)

| SECTION | TITLE | No. of Sheets. |
|-----------|--|----------------|
| 1 | Suggestive Price Format | 2 |
| 2 | Gauranteed Power consumption Figures | 1 |
| 3 | Format – No Deviation Certificate | 1 |
| SECTION-F | LIST OF ENCLOSURES | |
| 1 | Schematic for Compressed Air Plant- PE-DG-372-555-A501 | 1 |



**COMPRESSED AIR SYSTEM
SCOPE OF ENQUIRY**

Specification No: PE-TS-372-555-A001

VOLUME IIB

SECTION - A

Rev 00

DATE: 16.06.2012

SHEET 1 of 1

1. SCOPE

This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing, delivery to site, supervision of erection and commissioning, final painting & carrying out acceptance tests at site of Compressed Air system as mentioned in the different Section of this specification for Marib GTPS, Yemen.

2. GENERAL TECHNICAL INSTRUCTIONS

2.1.1 This volume IIB covers requirements of design, engineering, manufacture, and delivery to site, supervision of erection & commissioning of the complete plant. The requirements specified under Volume-I, Volume-IIA & Volume-IIC shall be considered as a part of Volume-IIB.

2.1.2 It is not the intent to specify herein all the details of design & construction. However, the equipment shall conform to high standards of design, engineering & workmanship in all respects and shall be capable of performing the required duties in a manner acceptable to owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

2.1.3 In case of any Technical Deviation, the Bidder shall indicate the same clause by clause in the enclosed schedules. In the absence of duly filled schedules, it will be construed that the bid conforms strictly to the specification.

2.1.4 The bidder may offer optionally the standard design of equipment indicating the deviations from the specification. However, feedback reports must be furnished of equipment performance. The acceptance of optional equipment shall not be binding on Purchaser.

2.1.5 The requirements mentioned in Section-'C'/ Data Sheet-'A' of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the description portion in Section-D

164



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV. 00

DATE 20/07/2012

SHEET

SECTION-B

PROJECT INFORMATION



TITLE

**COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

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 |



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

| | | |
|-------------|---|---------------------------|
| 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. |

162

PEM-6666-0



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

SECTION-C1

SPECIFIC TECHNICAL REQUIREMENT

8



**SPECIFIC TECHNICAL
REQUIREMENT
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME - IIB

SECTION C

REV. 00

DATE: June 2012

SHEET 2 OF 7

1. INTENT

- 1.0.1 The purpose of this document is to bring out clarity with regard to the following:
- a) System description and Basic operation & Control Philosophy
 - b) Major technical requirements of various items covered under this package
 - c) Scope, terminal points (if any), exclusion (if any).
- 1.0.2 Approved copy of this document shall form the basis for subsequent approval of Compressed Air System vendor documents (by Client /their consultant or by BHEL)
- 1.0.3 In case of any contradictory requirement indicated in this document and those in the tender documents, details given in approved copy of this document (Design Memorandum) shall prevail.

2. GENERAL DESCRIPTION

The compressed air system is comprised of the instrument air system and the plant air system. Instrument air is required for the various pneumatically operated valves and instruments in the power plant, while plant air is required for general plant services.

3. DESIGN CRITERIA

3.1 System Design Criteria

Compressed air system includes the following:


- 3.1.1 Two (2) nos. (1 working + 1 standby) Instrument air compressors and two (2) nos. (1 working + 1 standby) Service air compressor, including drives, intercoolers, after coolers, step up gearbox, silencer and other accessories. Compressor shall be air cooled oil free screw or air cooled rotary tooth type.
- 3.1.2 Two (2) nos. (1 working + 1 standby) air-drying plants (ADP) each suitable for connecting to individual instrument air compressor. ADP shall be air-cooled refrigerant type.
- 3.1.3 Intake air filters.
- 3.1.4 Four (04) nos. air receivers as follows:
- Four (04) nos. air receive of 6 M3 capacity, i.e., one no. for each compressor near compressor house.
- 3.1.5 All interconnecting piping, valves, fittings, supports/hangers, control air tubing (complete with valves and fittings between air receiver, compressor and local panel for each compressor), cooling water piping & valves for safe and satisfactory operation of air compressors.
- 3.1.6 Controls & interlocks and instrumentation.

3.2 Equipment Design Criteria

3.2.1 AIR COMPRESSORS

- 3.2.1.1 The capacity of Instrument air compressor shall be 6 NM³/min. Delivery pressure will be 8.0 Kg/cm² (g) at outlet of IA compressor & 7.5 kg/ cm² (g) at ADP outlet. Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.
- 3.2.1.2 The capacity of Service air compressor shall be 6 NM³/Min. Delivery pressure will be 8.0 Kg/cm² (g) at outlet of SA compressor.

9

| | | | |
|---|---|---|------------------------|
|  | SPECIFIC TECHNICAL REQUIREMENT COMPRESSED AIR SYSTEM | SPECIFICATION NO. PE-TS-372-555-A001 | |
| | | VOLUME - IIB | |
| | | SECTION C | |
| | | REV. 00 | DATE: June 2012 |
| | | SHEET 3 OF 7 | |

| | |
|----------|---|
| 3.2.1.3 | Air compressors will be multi stage air cooled oil free, screw type/ air cooled rotary tooth type. |
| 3.2.1.4 | The compressors' capacity will be designed for 45 ⁰ C DBT and 60% RH at atmospheric pressure at site & at MSL of 1100m. |
| 3.2.1.5 | Testing of compressor will be as per ISO: 1217. |
| 3.2.1.6 | Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement. |
| 3.2.1.7 | The continuous motor rating (at 50 ⁰ C ambient) will be at least fifteen percent (15%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin. |
| 3.2.1.8 | Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc. |
| 3.2.1.9 | Noise level shall not exceed 85 dBA plus tolerances as per IS standard to a reference level of 0.0002 microbar when measured at a distance of 1.0 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow off silencer and intake silencers shall be designed to meet the above noise limitation level. |
| 3.2.1.10 | Compressed air velocity shall be limited to 15 m/sec. |
| 3.2.2 | AIR DRYING PLANT Air-drying plant shall be of heat of air cooled refrigerant type, drying by adsorption process through a desiccant medium. The capacity of ADP shall be 6 NM3/Min each. Atmospheric pressure dew point shall – 20 deg C. Line pressure dew point shall be + 4 deg C |
| 3.2.3 | INTER COOLER, AFTER COOLER & OIL COOLERS |
| 3.2.3.1 | Inter cooler, after cooler & oil cooler shall be air cooled. |
| 3.2.3.2 | The coolers shall be designed for the max. heat load & at least 10 % design margin shall be provided in the tubes. |
| 3.2.3.3 | Adequately sized safety valve shall be provided for both inter cooler & after cooler. |
| 3.2.3.4 | Each intercooler & after cooler shall be provided with moisture separator unit with suitable baffling. Electrically operated automatic drain trap station with bypass valve & isolation valves shall be provided for moisture separator for automatic draining of condensed moisture. Manual draining facility shall also be provided. |
| 3.2.4 | INTAKE FILTER |
| 3.2.4.1 | Heavy duty dry type suction air filters will be provided at the compressor inlet to prevent dust and dirt from entering the compressor chamber. |
| 3.2.4.2 | The filtering efficiency shall not be less than 99% for particles 3 micron & higher. Sound suppressing characteristics will be considered in the filter design. |



**SPECIFIC TECHNICAL
REQUIREMENT
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME - IIB

SECTION C

REV. 00

DATE: June 2012

SHEET 4 OF 7

3.2.5 AIR RECEIVER

The capacity of each air receiver shall be 6 M³ (nominal).

The air receivers will be vertical self-supporting cylindrical vessels with supporting legs for resting on their foundation.

Design Pressure for the air receiver shall be 12 kg/cm² (g) and 50degC respectively.

The material of construction of shell, dished ends, flanges etc of the air receivers shall be of carbon steel as **SA 516 Gr. 70** or equivalent.

Air receiver shall be provided with nozzles, air release vents, safety valve, pressure gauge, temperature gauge, minimum 500 mm dia. manhole for inspection.

3.2.6 PIPING & VALVES (WITHIN COMPRESSOR HOUSE)

All interconnecting compressed air piping shall conform to IS 1239 heavy galvanised to IS- 4736 or equivalent. The fitting shall be ASTM A234 Gr WPB. Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60 deg. C. The pipe joints will be screwed coupling type for sizes up to 50 NB and above 50 NB the same will be flanged.

All the distribution valves shall be ball valve type. Necessary auto drain shall also be provided at strategic points.

All Airlines shall be screwed connection and rubber lined pipes of flanged connection.

VALVES

a) Compressed Air Services:

- ♦ All airline valves shall be ball valve type. For compressed air application, valve material shall be galvanized cast carbon steel as mentioned below:

| SIZE | BODY BONNET | DISC | STEM | HAND WHEEL | VALVE ENDS |
|---------|-----------------------|------------------------|--------------------------------|---------------------------|---------------------------|
| ≥ 65 NB | ASTM A 216 Gr. WCB | ASTM A 216 Gr WCB | ASTM A479 Type 410-2 | ASTM A47 Gr. 32510 | FLANGED RAISED FACE |
| ≤ 50 NB | ASTM A 105 | 13% Cr Steel (Ball) | ASTM A479 Type 410-2 | ASTM A47 Gr. 32510 | SCREWED TYPE |

b) Auto drain trap for each air receiver shall be provided.

c) Moisture traps at strategic locations shall be provided in the distribution network.

4. LAYOUT CONSIDERATIONS

4.1.1 Air compressors will be located indoor in a separate compressor room.

4.1.2 The air receivers will be located outdoors adjacent to the compressor room.

4.1.3 Complete ADP equipment shall be preferably mounted on a skid and located indoor.

11



**SPECIFIC TECHNICAL
REQUIREMENT
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME - IIB

SECTION C

REV. 00

DATE: June 2012

SHEET 5 OF 7

5. OPERATION, CONTROL & INSTRUMENTATION

- 5.1.1 The necessary instrumentation and control has been provided for safe and trouble free operation of compressed air system.
- 5.1.2 Individual compressor control shall be through microprocessor based control system as per manufacturer's standard.

6. POWER SUPPLY ARRANGEMENT

- 6.1.1 The power supply (rated voltage, frequency, phase) of the equipments will be 3.3 KV, 415 V +/- 10%, 3ph, 50 Hz +5% to -5%. 10% combined variation of voltage and frequency.

7. GENERAL

- 7.1.1 Compressed Air system shall be offered as turnkey basis (supply, supervision of erection & commissioning) meeting specification requirements.
- 7.1.2 Base plates and foundation bolts including anchor bolts, nuts, loose fittings etc. for equipment and as would be necessary for erection and complete anchoring of steel materials for the pipes, hangers and supports and Compressors, Air receivers etc. Anchor fasteners shall be in the scope of bidder.
- 7.1.3 Compressed Air plant supplier to follow Schematic for Compressed Air Plant, BHEL drg no. PE-DG-372-555-501 Rev 00 indicating scope of supply attached with this specification. Following shall be noted in addition to above:
- Air pipe sizing shall be done by considering compressed air velocity not exceeding 9 m/s.
 - Compressed air plant supplier shall provide microprocessor based controls for compressor pack.
- 7.1.4 Painting Specification is enclosed. The painting procedure for the subject package will be subject to BHEL/Customer approval during detail engineering stage. However, compressor pack to be provided with powder coated epoxy paint only.
- 7.1.5 Codes and Standards shall be as per Annexure – I.
- 7.1.6 Basis of design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drg. and documents like data sheet/Technical particulars etc. are subject to BHEL / Customer approval during detail engineering stage.
- 7.1.7 All drawings and documents shall be computer based.
- 7.1.8 All commissioning spares & consumables for trouble free operation shall be provided.
- 7.1.9 First fill of lubricants & consumables for all equipment in Compressed Air System shall be in the scope of bidder.
- 7.1.10 Supply of special tools and tackles including toolbox required for operation, maintenance and overhauling of the system shall be in the scope of bidder.
- 7.1.11 Drawings, Data and instruction manual for the system as per drawings / documents distribution schedule required by customer shall be in the scope of bidder.
- 7.1.12 Quality Plans attached with the specification are indicating minimum requirements for inspection and testing. Bidder to note that quality plans is subject to BHEL/Customer approval during detail engg. Stage.
- 7.1.13 List of make is enclosed as per Annexure-II. Makes of equipment shall be subject to BHEL/Customer approval.
- 7.1.14 Bidder must indicate make of equipment clearly in the offer. The words "equivalent / reputed make" are not acceptable.



**SPECIFIC TECHNICAL
REQUIREMENT
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME - IIB

SECTION C

REV. 00

DATE: June 2012

SHEET 6 OF 7

- 7.1.15 Unit rates for all the items in mandatory spares list shall be furnished separately by the bidder.
- 7.1.16 The tools and tackles required for regular maintenance shall be supplied by compressed air plant supplier.
- 7.1.17 **The following (minimum) shall be demonstrated at shop:**
- 7.1.17.1. Capacity and discharge pressure of each compressor.
- 7.1.17.2. Power consumption of each air compressor at its rated duty point with its own motor.
- 7.1.18 **The following (minimum) shall be demonstrated at site:**
- 7.1.18.1. Parallel Operation of air compressors.
- 7.1.18.2. Vibration and noise level of air compressors.
- 7.1.19 Instrument for testing shall be calibrated by compressed air plant supplier before taking up testing.
- 7.1.20 All motors shall be in accordance with the technical specification enclosed hereinafter. Deviation, if any, shall be clearly brought out in schedule of deviation.
- 7.1.21 Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 7.1.22 Electrical items to be provided by compressed air plant shall be as indicated elsewhere in the specification
- 7.1.23 Technical specification for control and instrumentation items to be provided by compressed air plant shall be as indicated elsewhere in the specification.
- 7.1.24 The above clauses specify equipment for general guidance only. Any other equipment and / or material necessary to ensure safe & satisfactory erection, commissioning & operation of the plant shall be included in bidder's scope & brought out clearly. The detail design & equipment sizing shall be in the bidder's scope of supply.
- 7.1.25 The bidders proposal shall be for equipment in accordance with the Tech. Specification.
- 7.1.26 Bidder to clearly note that there is no deviation from the tech specification other than those indicated in their offer under "DEVIATION OF TECH. SPECIFICATION" Bidders shall also note that the deviation in any other form except above is not acceptable (i.e. in data sheet or other Annexures or elsewhere in this offer) and same shall not be considered for review/evaluation purpose/comments and it is assumed that the system/material/equipment have been offered strictly in line with specifications/requirements.

8. EXCLUSIONS

Items of works listed below are excluded from scope of the compressed air plant supplier.

- 8.1.1 Civil works including construction of compressor house, foundation of all compressor, and air receiver, pipe/cable trenches.
- 8.1.2 Lighting and ventilation of compressor house.
- 8.1.3 Handling arrangement in the compressor house.
- 8.1.4 Compressed Air Distribution Piping running compressed air header after the air receivers outside the compressor house.

(15)



**SPECIFIC TECHNICAL
REQUIREMENT
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME - IIB

SECTION C

REV. 00

DATE: June 2012

SHEET 7 OF 7

- 9. DRAWINGS / DOCUMENTS TO BE FURNISHED BY BIDDER ALONG WITH TECHNICAL OFFER**
- 9.1.1 Scope of work along with system description, equipment being supplied including mandatory spares & commissioning spares.
- 9.1.2 "Deviation of Technical Specification", if any.
- 9.1.3 P&I Diagram of compressed air system.
- 9.1.4 Space requirement / layout of compressor house.
- 9.1.5 Handling arrangement requirement for maintenance purpose.
- 9.1.6 Completely filled Data Sheet B of compressed air system and other instruments attached with the Technical Specification.
- 9.1.7 Quality Plans for the compressor, motor, valves, instruments etc, duly signed by the bidder, to be furnished along with the Technical Offer.

(14)



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

SECTION-C2

CUSTOMER TECHNICAL SPECIFICATION

158

FICHTNER

Volume - IV

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 1 |

(PEC TENDER NO.: 12/2008)

VOLUME IV
SECTION 7.2
COMPRESSED AIR PLANT

FORMT9-P REV-B

16

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 2 |

(PEC TENDER NO.: 12/2008)

Table of Contents

| | | |
|-------|--------------------------------|----|
| 7.2.0 | COMPRESSED AIR SYSTEM | 3 |
| 7.2.1 | GENERAL | 3 |
| 7.2.2 | SCOPE OF WORK | 3 |
| 7.2.3 | COMMON EQUIPMENT AND SERVICES | 4 |
| 7.2.4 | TECHNICAL REQUIREMENTS | 5 |
| 7.2.5 | SPECIFIED DESIGN DATA | 8 |
| 7.2.6 | TECHNICAL DATA BY THE TENDERER | 9 |
| 7.2.7 | GUARANTEES, REJECTION | 13 |

FICHTNER

Volume - IV

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. 3 |

7.2.0 Compressed Air System

7.2.1 General

The compressed air system shall provide supply of compressed air having suitable pressure and quality of Service air for cleaning of filters, strainers and general purpose and for instrument and Instrument Air for operation of I/P converters, purge instruments, pneumatic actuation of control valves, dampers, etc. for different systems.

This specification includes, the design, manufacture, supply, testing, erection & commissioning of complete Compressed Air Plant. The enclosed drawing No. 30-7195-M-005 shall be referred.

The proposed Compressed Air Plant shall be designed as per the design criteria and material specification given in this specification.

If any provision of the specification departs from the Contractor's usual construction sufficiently to materially increase the cost of the equipment without in his opinion providing corresponding increase in quality/reliability or if he considers that his standard construction would provide better quality/reliability he shall offer the equipment/system on the basis of his standard construction. In case such offer is made, the Contractor shall state very clearly the merit of his offer and the demerits, (in his opinion) the specified equipment/system, has and the deviations taken against the specification are to be clearly stated in the "Deviation Schedule" without which it will be considered that the Contractor complies to the specification requirements. However the Contractor shall not make any changes on the offered equipment during execution.

7.2.2 Scope of Work

This section sets out the scope of the installations covered by this specification as well as required supplies and services but without excluding other necessary components and services not mentioned.

- Two (2) Nos. of compressor (2 x 100%) each for Instrument Air (IA) and 2x100% for Service Air (SA) system of non lubricated, oil free reciprocating, two stage complete with suction filter, silencer, intercooler, aftercooler, lubricating system, baseplate, etc.
- 2 x 100% Air drying plant complete with prefilter, after filter (fine filter), etc.
- Service air receiver and Instrument air receiver, one each
- Interconnecting piping between the equipment supplied for both instrument & Service air with necessary valves, fittings, etc.

Pipe work

Complete piping networks required for distribution of instrument air and service air including compensators, impulse tubing, automatic operating devices, supports, fasteners, necessary automatic condensate traps, isolating valves, bypass control valves, fittings, etc, including the following particular items:

- discharge line check valves
- discharge line overpressure relief valves

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 4 |

Control and monitoring equipment

- completely wired, equipped and factory tested local control board for the compressed air plant including:
 - i) independent compressor control devices (connected to the main air receivers)
 - ii) automatic start and stop control combined with loading and unloading devices as required and described in this specification.
- All signalling annunciators, pressure gauges, thermometers, flow meters, safety valves, etc. for in-line mounting of networks
- Pressure-reducing valves and control valves where necessary
- All necessary local measuring, control, instrumentation and monitoring equipment, including cabling, sensors, etc. as well as additional instrumentation necessary to suit any special design features of the plant and its accessories.

7.2.3 Common equipment and services

- All general services as required such as transport, erection, commissioning, trial operation, testing, training on site, supervision of operation and maintenance during guarantee period, etc. as stipulated in Vol.II
- All necessary base frames, base plates, anchor bolts, supports, covers, etc.
- Spare parts as stipulated in Section 10.0 of Vol.II.
- All necessary venting, draining & emptying equipment,
- All necessary insulation as required in section 7.7 of Vol. IV
- All necessary painting, corrosion protection & preservation measures as required in section 7.6 of Vol. IV
- Complete detailed labelling of all installations as required in section 13.0 of Vol. II
- Documentation according to section 12.0 of Vol. II
- Complete electrical system including drive motors suitable for area specified, control panel, local push button stations, transformers rectifier set, power & control cables, cabling complete with supports, cable trays, glands, lugs, for the successful operation of the plant. The electrical system shall confirm to the requirements specified Section 8.0 of Vol. V
- All consumables as per section 3.0 of Vol. II
- One set of special tools, tackles and equipment as stipulated in Section 11.0 of Vol.II.
- All standard equipment and accessories normally included in the supply schedule but not separately listed.

156

FICHTNER

Volume - IV

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 5 |

7.2.4 TECHNICAL REQUIREMENTS

The requirements specified in section 17.0 of Vol. II are to be applied as well as further regulations from the other sections of this specification.

The installation and dismantling of the various parts of the equipment must not present any great difficulty and appropriate design features must be incorporated for this purpose.

7.2.4.1 Compressors, drives and transmissions

The air compressors are to be of the dry running (non lubricated, oil free) reciprocating type with two stages.

Compressors shall have intercoolers and after-coolers. Compressors offered shall be well balanced, requiring light foundations, preferably soleplate-mounted factory-tested units. Preference will be given to reciprocating compressors working at relatively low speed.

The suction and discharge valves of the reciprocating compressors are to be of sufficient size and so designed that wire-drawing and air-baffling are reduced to a minimum. They are to operate without shock.

Compressors are to be complete with all necessary drain valves, drain pipes, relief valves, inlet and outlet air valves, sight feed lubricators, pressure gauges, thermometer pockets and other necessary fittings. Appropriate instrumentation shall be provided to monitor the lubricating oil system of the compressors. The compressor design shall comply with recognized International Standards.

The compressors are to be driven by electric motors. The drives are to be sized with an appropriate load factor and service factor to overcome the maximum torque at the minimum air temperature in the intake. The motor rating shall have a margin of 15% over BKW at duty point.

Directly coupled motors with flexible coupling or multiple V-belt transmission shall be employed. V-belts are to be furnished in matched sets and shall be of heavy duty of premium quality rating, oil resistant & have static conducting characteristics. Flat belt transmission, Planetary gear or chain transmission are not permitted.

Particular emphasis shall be placed on satisfactory machinery, sound and vibration isolation. Care must be taken, by introducing appropriate amplitude dampers, that resonance does not take place as a result of an insufficient margin between the natural frequency of the installation, or multiples thereof, and the existing frequency in normal operation. Moreover, the critical speed of the compressor and drive, taken together, shall have a sufficient margin from the normal operating speed. No vibration of the building or building floor stemming from the normal operation of the compressors units will be acceptable. If necessary, the foundations of the compressors units are to be installed as separate foundation slabs with spring elements supported on the building floor.

7.2.4.2 Aftercoolers and Intercoolers

Intercoolers and after coolers shall be of air cooled type. The design of the coolers must permit the tube nest to be withdrawn in one piece from the shell to facilitate cleaning. Electrically actuated automatic arrangements must be provided for draining the moisture condensed during cooling from the cooler air space. The coolers shall be designed to the requirements of ASME Code Section – VIII for unfired pressure vessels. The coolers shall be pressure tested at 1.5 times of the working pressure.

FORMTSP REV.B

20

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 6 |

7.2.4.3 Air dryers

2 x 100% Refrigerant type air dryer unit shall be provided to made moisture free air. The dryer shall be designed to made dry air at an atmospheric dew point of -40°C.

Where the inlet air temperature to the air dryer exceeds 50°C the dryer shall incorporate a pre-cooler in order to optimize the dryer package sizing. The pre-cooler shall be packed in a common base plate of the dryer.

7.2.4.4 Air filters

The inlet filters are to be designed for the maximum throughout of the respective compressor. All other filters are to be designed for the maximum throughout equal to the output of all duty compressors together if more than one duty compressor will be provided. Automatic and maintenance-free working conditions are mandatory during normal operation.

The inlet filters are to be suitable for operation in a dust-laden atmosphere. The minimum lifetime of these filters has to be 16000 working hours.

The prefilter and fine filters shall allow for service time intervals no shorter than 1000 working hours. They shall be equipped with electrically actuated condense traps.

7.2.4.5 Air receivers

The air receivers shall be sized, designed and constructed according to ASME SEC VIII for unfired pressure vessel, division - I. They shall be of the vertical type with dished ends, welded construction suitably coated against corrosion, complete with all connection, instruments, relief valves, lifting brackets, electrically operated moisture traps, manholes (500 mm diameter), etc. The air receivers shall be constructed of carbon steel plates conforming to ASTM A-283 Gr.C.

7.2.4.6 Piping

The general requirements for piping shall comply with the stipulations laid down in section 7.5 of Vol. IV. The piping shall be designed, fabricated and tested in accordance with the relevant standards as agreed by the purchaser, incorporating any other features required by this specification.

No pipework shall be buried unless expressively approved by the purchaser. Where a pipe passes under a road special precautions are to be taken to ensure that no damage is done to the pipe by traffic and that no subsidence of the road will occur. All buried piping shall have fusion-welded joints tested for air-tightness before they are covered.

Integral pipework layout and compressor connections shall avoid straight pipes of such lengths that the column of air inside the pipe would vibrate at the same frequency as the pulsation from the reciprocating air compressors.

A connection from the service air network to the instrument air network shall be provided in such a way that in case of emergency service air compressors can supply air to instrument air system and not vice versa.

Gaskets shall be supplied precut. Gaskets for flat faced flanges shall be full faced.

Service air tapping points in the service air system shall be supplied in sufficient number within the entire plant. An isolating valve complete with a quick release hose connection shall be provided on all tapping points, with in easy access of the operating personnel.

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 7 |

Pressure gauges shall be provided at extreme ends of the instrument air headers. For both systems suitable connection with blind flanges for future connection shall be provided.

All piping other than threaded shall be fabricated with fusion-welded joints except where flange connections are specified or are required to facilitate erection or maintenance. Connections to machinery or equipment such as receivers, etc. are to be flanged.

Instrument and service air system of Phase II shall be interconnected with Phase I instrument and service air system with isolation valves.

7.2.4.7 Control and Instrumentation

All necessary operational controls, regulating controls, automation, measuring and monitoring required to cope with the equipment duty are to be so designed and arranged such that operation of the plant can be fully automatic or, if required, fully manual. All necessary interlocking and alarm circuits shall be arranged so as to eliminate any possible damage to the plant due to mal functioning of instruments or any probable operational mistakes. Technical features of the controls and instruments shall basically comply with the applicable general requirements of Section 9 of Vol. V & Section 17 of Vol. II.

It must be possible to start the compressed air plant from a common floor-mounted local board. Only those common alarms which are required to indicate malfunctions or failure of the compressed air plant shall be transmitted to the central control room.

An auto/manual selection shall be arranged in such a way that any of the compressors may be selected, the operation of the stand-by compressor shall be controlled by pressure switches located at the main receivers.

Changeover from manual to automatic or vice versa shall occur without interruption.

When the pressure in instrument air receiver falls below the preset value then the supply of air to plant service shall be cut off through a solenoid valve.

Adaption of the specified scope and design of the control and Instruments shall be done where needed for matching the special versions and requirements of apparatus and plant equipment.

22

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 8 |

7.2.5 SPECIFIED DESIGN DATA

| DESCRIPTION | MINIMUM REQUIREMENTS | |
|---|----------------------|---------------------------------|
| | Unit | Data |
| Max. ambient temperature | °C | 45 |
| Max. humidity | % | 60 |
| Attitude above MSL | m | 1100 |
| Site ambient pressure | bar | 0.8877 |
| Capacity of each compressor referred to the total max. compressed air requirement of the entire unit. | % | 120 |
| Number of compressors | No | 4 (2 x 100% each for IA and SA) |
| Pressure at instrument air receiver outlet | bar (g) | ≥ 7 |
| Max. air temperature at aftercooler outlet | °C | 50 |
| Max. atmospheric dew-point | °C | -40 |
| Number of drier | No | 2 x 100% |
| Capacity of air dryer referred to total max. instrument air requirement of the entire unit | % | 125 |
| Storage capacity of Service air receiver | minutes | 5 |
| Storage capacity of Instrument air receiver | minutes | 5 |

23

FICHTNER

Volume - IV

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. 9 |

7.2.6 TECHNICAL DATA BY THE TENDERER

| DESCRIPTION | UNIT | DATA |
|---|---------------------|------|
| General | | |
| Nominal steady-state compressed air requirement including pipe losses and instrument losses of the entire unit to be considered, if all plants are in operation and produce 100% output continuously. | Nm ³ /hr | |
| Max. total compressed air requirement for the whole plant (at 1.013 bar & 0°C) | Nm ³ /hr | |
| Max. instrument air requirement for entire plant (at 1.013 bar & 0°C) | Nm ³ /hr | |
| Instrument Air system Pressure | bar (g) | |
| Switch-on pressure in main receivers for : | | |
| - duty compressor | bar (g) | |
| - stand-by compressor | bar (g) | |
| Compressor | | |
| Number of compressors | - | |
| Make, Model No. | - | |
| Design code | - | |
| Capacity of the each compressor (at 1.013 bar & 0°C) | Nm ³ /hr | |
| Air pressure at aftercooler outlet | bar (g) | |
| Testing code | - | |
| Number of stages | - | |
| Speed of compressors | rpm | |
| Number of cylinders | - | * |
| Type of bearings | - | * |
| Type of bearing lubrication | - | * |
| Method of no-load control | - | |

FORMT9-P REV/B

24

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 10 |

| DESCRIPTION | UNIT | DATA |
|--|-------------------|------|
| Type of transmission | - | * |
| Shaft power | KW | |
| Motor rating | KW | |
| Materials : Crankshaft Connecting rod Piston Piston rod | - | |
| Driving motor: | | |
| Make | - | * |
| Speed | rpm | |
| Rating | kW | |
| Oil pump | | |
| Rate of delivery | m ³ /h | * |
| Rating (in case of separate motor) | KW | * |
| Intercooler | | |
| Design Code | - | |
| Max. air outlet temperature | °C | |
| Material of tubes | - | |
| Aftercooler | | |
| Design Code | - | |
| Max. air outlet temperature | °C | |
| Material of tubes | - | |
| Air dryer | | |
| Number of air dryers | - | |
| Make, Model No. | - | * |
| Type | - | |

FORMT9-P REV-B

25

FICHTNER

Volume - IV

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. 11 |

| DESCRIPTION | UNIT | DATA |
|--|---------------------|------|
| Capacity of the air drier | Nm ³ /hr | |
| Air inlet temperature | °C | * |
| Air outlet temperature | °C | |
| Atmospheric Dewpoint | °C | |
| Pressure loss in dryer | bar | * |
| Rated power demand (if applicable) Heater | KW | * |
| Motor (for Blower) | KW | * |
| Prefilter | | |
| Number of filters | - | |
| Max. throughput of one filter (at 1.013 bar & 0°C) | Nm ³ /hr | * |
| Mesh size | µm | * |
| After-filter (fine filter) | | |
| Number of filters | - | |
| Max. throughput of one filter (at 1.013 bar & 0°C) | Nm ³ /hr | * |
| Mesh size | µm | * |
| Service Air receiver | | |
| Number of air receivers | - | |
| Make | - | |
| Design Code | | |
| Capacity | m ³ | |
| Pressure at receiver outlet | bar (g) | |
| Design pressure | bar (g) | |
| Total height | mm | * |
| Diameter of receiver | mm | * |
| Material | - | |

FORMTSP REV-B

26

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 12 |

| DESCRIPTION | UNIT | DATA |
|---|----------------|------|
| Protection against corrosion: | | |
| Internal | - | * |
| External | - | * |
| Instrument Air receiver | | |
| Number of air receivers | - | |
| Make | - | |
| Design code | - | |
| Capacity | m ³ | |
| Pressure at receiver outlet | bar (g) | |
| Design pressure | bar (g) | |
| Total height | mm | * |
| Diameter of receiver | mm | * |
| Material | - | |
| Protection against corrosion: | | |
| Internal | - | |
| External | - | |
| Pipework | | |
| Materials and relevant standard of pipework to be stated in detail | - | |
| Note | | |
| * In the data sheet indicate the data may be furnished after award of contract. All other data to be filled in by the Tenderer during Bid stage itself. | | |

FICHTNER

Volume - IV

| Project | Subject | 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 | 7.2 |
| | | | | Sheet No. |
| | | | | 13 |

7.2.7 GUARANTEES, REJECTION

| DESCRIPTION | UNIT | DATA |
|--|---------------------|------|
| GUARANTEES | | |
| Max. air temperature at aftercooler outlet | °C | 50 |
| Atmospheric Dew point of instrument air | °C | -40 |
| Air intake temperature (dry bulb) | °C | |
| Relative humidity | % | |
| Atmospheric pressure | bar | |
| Compressor | | |
| Capacity of one compressor (at 1.013 bar & 0°C) | Nm ³ /hr | |
| Air dryer | | |
| Capacity of one dryer (at 1.013 bar & 0°C) | Nm ³ /hr | |
| Pressure loss at max. throughput | bar | |
| Instrument air receiver outlet pressure | bar (g) | |
| Power demand | | |
| Power demand at full load operation of | | |
| - One instrument air compressor | kW | |
| - One service air compressor | kW | |
| - One air dryer | kW- | |
| Noise Pressure Level | db | |
| (at a distance of 1.0 m away from the equipment) | | |
| REJECTION | | |
| Should the deterioration of the guarantee values be greater than following values then the purchaser shall have the right to reject the equipment concerned. | | |
| Compressor capacity | % | 4 |
| Atmospheric dew point of instrument air | C | -1 |
| Power demand | % | 5 |

| 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 | 7.5 |
| | | | | Sheet No. |
| | | | | 1 |

(PEC TENDER NO.: 12/2008)

VOLUME IV
SECTION 7.5
PIPING, VALVES AND FITTINGS

FORMT9-P REV.B

29

(157)

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-EPC-700-001 | C | 7.5 |
| | | | | Sheet No. |
| | | | | 11 |

PIPE CLASS : PC7

- | | | |
|--------------------|---|--|
| 1. Service | : | Instrument Air, Service Air, Potable & Service water |
| 2. Material | : | A 53 Gr. B. galvanised |
| 3. Dimensions | : | B 36.10 |
| 4. End finish | : | Threaded to NPT. To be supplied with coupling at one end. For sizes ≤ 40 NB, bevelled for sizes ≥ 50 NB |
| 5. Test | : | Hydro test required and others as per code. |
| 6. Galvanising | : | Zinc coated inside and outside by hot dip process, |
| 7. Certificates | : | Material and hydro test certificates required. |
| 8. Product Marking | : | Manufacturer's name, Specifications, OD and Thickness. |

FORMT9-P REV-B

(50)

| 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 | 7.5 |
| | | | | Sheet No. |
| | | | | 15 |

FITTING CLASS : FC7

Service : Instrument Air (IA), Service Air (SA), Potable Water (PW) & Service Water (DW).

I. Bends, Elbows & Tees

- 1. Material : A 105, Galvanised
- 2. Design/dimensions : ASME B 16.11
- 3. Ends : Threaded to NPT
- 4. Certificates : Chemical and mechanical properties, hydro test certificates

II. Flanges

- 1. Material : ASTM A105 GALVANISED
- 2. Type/End : Threaded to NPT
- 3. Design/Dimension : ANSI B 16.5

III. Gaskets

- 1. Material : CAF
- 2. Design : ANSI B 16.21

IV. Bolts and Nuts

- 1. Material : A 193 Gr B7, A 194 Gr 2H
- 2. Test : Tensile test
- 3. Certificates : Chemical and tensile test certificates

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-EPC-700-001 | C | 7.5 |
| | | | | Sheet No. |
| | | | | 22 |

- VALVE CLASS : VC7**
- 1.0.0 GATE/GLOBE VALVES**
- 1.1.0 Design/Construction
- 1.1.1 Service : Instrument air, Service air, Service water & Potable water
- 1.1.2 Ends : Screwed for ≤ 100 NB, flanged for > 100 NB
- 1.1.3 Design/Dimensions : ANSI B16.34/B 16.10/BS : 5352/BS : 1873
- 1.1.4 Type : ---
- 1.1.5 Bonnet connection : Screwed/Flanged

FORMT9-P REV-B

32

| 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 | 7.5 |
| | | | | Sheet No. |
| | | | | 23 |

| | | | |
|--------|---------------------|---|---|
| 1.1.6 | Actuator | : | - |
| 1.1.7 | Seat | : | Hardened |
| 1.1.8 | Back seat | : | - |
| 1.1.9 | Hand wheel | : | Required |
| 1.1.10 | Sealing equipment | : | |
| 1.2.0 | Material | | |
| 1.2.1 | Body | : | ASTM A181/ASTM A105 |
| 1.2.2 | Bonnet | : | ASTM A181/ASTM A105 |
| 1.2.3 | Seat | : | CS hardened |
| 1.2.4 | Wedge/Plug | : | ASTM A181 |
| 1.2.5 | Stem | : | CS |
| 1.2.6 | Gasket (Bonnet) | : | - |
| 1.2.7 | Gland | : | Brass |
| 1.2.8 | Packing | : | Expanded PTFE stem packing |
| 1.2.9 | Yoke sleeve | : | Brass |
| 1.2.10 | Hand wheel | : | CS |
| 1.2.11 | Studs | : | ASTM A193 Gr. B7 |
| 1.2.12 | Nuts | : | ASTM A194 Gr. 2H |
| 2.0.0 | CHECK VALVES | | |
| 2.1.0 | Design/Construction | | |
| 2.1.1 | Service | : | Instrument air, Service air, Service water & Potable water |
| 2.1.2 | Ends | : | Screwed for \leq 100 NB, flanged for $>$ 100 NB |
| 2.1.3 | Design/Dimensions | : | ANSI B16.34 / ANSI B16.10 / BS : 5352 / BS : 1868 |
| 2.1.4 | Type | : | Swing check |
| 2.2.0 | Material | | |
| 2.2.1 | Body | : | ASTM A181/ASTM A105 |
| 2.2.2 | Disc | : | ASTM A181/ASTM A105 |

198

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-EPC-700-001 | C | 7.5 |
| | | | | Sheet No. |
| | | | | 24 |

- 2.2.3 Lever arm : CS
- 2.2.4 Arm nut : CS
- 2.2.5 Arm pin : CS
- 2.2.6 Seat ring : CS Hardened
- 2.2.7 Stud & Nut : ASTM A193 Gr. B7/ASTM A194 Gr. 2H
- 2.2.8 Cover plate : MS

FORMT9-P REV-B

34



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00


DATE 20/07/2012

SHEET

SECTION-C3

TECHNICAL SPECIFICATION (ELECTIRCAL PORTION)

(35)

| | | |
|---|---|---|
|  | <p align="center">TECHNICAL SPECIFICATION FOR</p> <p align="center">COMPRESSED AIR SYSTEM</p> <p align="center">(ELECTRICAL PORTION)</p> | <p>SPECIFICATION NO. PE-TS- VOLUME II B SECTION-C REV 00 DATE 28.05.12 PAGE 1 OF 1</p> |
|---|---|---|

ELECTRICAL EQUIPMENT SPECIFICATION FOR COMPRESSED AIR SYSTEM

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 [Scope of Work (Electrical)].
- 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 all AC loads required for the system at different voltage levels (eg. 400V AC etc.) of all types, such as motor feeders, supply 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 Compressed Air System 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 Matrix 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.
- 4.5 Load data format (Annexure-II).



ANNEXURE-I
ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: MARIB 400MW GTPS PROJECT, PHASE-II

PACKAGE: COMPRESSED AIR SYSTEM

| S.N | DETAILS | SCOPE SUPPLY | SCOPE E&C | REMARKS |
|------------|---|----------------------------|----------------------|---|
| 1 | 400V MCC | BHEL | BHEL | BHEL will provide 400V, 3-phase 4-wire supply. 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 | Local push button station (for motors) | BHEL | BHEL | Located near the motor |
| 3 | Power cables, ordinary control cables and screened control cables between equipments supplied by vendor. | Vendor | BHEL | |
| 4 | Power cables, ordinary control cables and screened control cables between equipments supplied by vendor & BHEL. | BHEL | BHEL | |
| 5 | Any special type of cable like compensating. Co-axial, prefab, MICC and fibre optical | Vendor | Vendor | |
| 6 | Illumination | BHEL | BHEL | |
| 7 | Cabling material (cable trays, accessories and cable tray-supporting system etc.) | BHEL | BHEL | |
| 8 | Marshalling Boxes/Junction Boxes for Power, control, instrumentation and special cable | Vendor | BHEL | |
| 9 | Conduits and conduit accessories for cabling between equipments by vendor | Vendor | BHEL | |
| 10 | Equipment earthing. | BHEL | BHEL | Arrangement at equipment end for earthing connection to be ensured by vendor. |
| 10 | Motors with Base frame and fixing hardware for motors. | Vendor | BHEL | |
| 11 | a) Input cable schedules b) Cable interconnection details. c) Cable block diagram | Vendor Vendor Vendor | - - - | Cable listing for control cables for vendor-supplied equipment (soft copies in the BHEL cable schedule format) shall be furnished during detail engineering by vendor. |
| 12 | Equipment layout drawings. | Vendor | - | Layout details between vendor supplied equipment and installation drawings by vendor |
| 13 | Cable glands and lugs for equipment supplied by vendor | Vendor | BHEL | 1. Double compression Ni-Cr plated brass cable glands (suitable for selected cable size). 2. Solder less crimping type heavy duty tinned copper lugs (suitable for selected cable size). |

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.

(37)



TITLE

**COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

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 | a. <u>Through sea:</u> <ul style="list-style-type: none"> Distance of site: From Aden Port (Gulf of Aden): 419 Km b. <u>By Air</u> : Sana'a Airport <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 |



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

| | | |
|-------------|---|---------------------------|
| 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. |

| 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

This specification covers the design, manufacture, supply, erection, testing and commissioning of Motors for various driven equipment and Actuators.

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.

8.8.2 Scope of work

The scope of work shall include but not limited to the following:

- 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

Motors shall conform to IEC and other applicable international standards amended upto date. Equivalent ANSI standards are also acceptable.

8.8.3.1 Motors

Design Features

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.

Inching type motors as per the requirement shall be provided.

The motor rating shall be at least 15% (service factor) over the maximum input power requirement of the driven equipment at rated point.

Continuously operating motors shall be of high efficiency type.

Power supply for AC motors shall be as follows:

- 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

FORM 19-P REV-B

41

| 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.

FORM 19-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 (CACA) 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.

FORM 19-P REV-B

43

FICHTNER

Volume - V

| 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.

FORMITSP 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.

45

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.

FORMATS-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. 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 motorsNo. 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)

FORM 19-P REV. B

47

142

FICHTNER

Volume - V

| 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

FORM 9-3 REV. B

48

FICHTNER

Volume - V

| 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 | - | |

FORM 19-2 (REV-8)

49

(14)

FICHTNER

Volume - V

| 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 | |

FORM 15-P REV-B

FICHT-4804071-v1-Sec_8.8_Motors_RRB.DOC

DJS/EL

50

| QUALITY PLAN | | CUSTOMER : | | PROJECT TITLE | | SPECIFICATION : | | | | |
|---|---|-----------------------|----|---------------------------------------|---|---------------------|---------------------|---------------|----|----|
| QUALITY PLAN | | BIDDER/ VENDOR | | QUALITY PLAN | | SPECIFICATION : | | | | |
| SHEET 2 OF 2 | | SYSTEM CAT. | | ITEM AC ELECT. MOTORS BELOW 55KW (LV) | | TITLE : | | | | |
| COMPONENT/OPERATION CHARACTERISTICS CHECK | | TYPE/ METHOD OF CHECK | | EXTENT OF CHECK | | SECTION AGENCY | | | | |
| 3. NAMEPLATE DETAILS | | VISUAL | | 100% | | P W V | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | | | MA | | | 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>Legends for Inspection agency</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 | | | | | | | | | | |
| NAME | | | | | | | | | | |
| SIGNATURE | | | | | | | | | | |
| DATE | | | | | | | | | | |
| BIDDER/VENDOR | | | | | | | | | | |
| BIDDER'S/VENDORS COMPANY SEAL | | | | | | | | | | |

52

150

53

| QUALITY PLAN | | CUSTOMER | | PROJECT | | SPECIFICATION | |
|--------------------------------|--|-----------------------------------|---------------|------------------|--------------|----------------------|--|
| SL. NO. | COMPONENT/OPERATION | QUALITY PLAN | BIDDER/VENDOR | TITLE | NUMBER | SECTION | VOLUME III |
| SHEET 1 OF 8 | | CHARACTERISTIC CHECK | CAT. | TITLE | ITEM AC ELEC | FORMAT | REMARKS |
| | | | | | | | |
| 1.0 | RAW MATERIAL & BOUGHT OUT CONTROL | 3 | 4 | 5 | 6 | 7 | 8 |
| 1.1 | SHEET STEEL, PLATES, SECTION, EYEBOLTS | 1. SURFACE CONDITION | MA | VISUAL | 100% | - | LOG BOOK |
| | | 2. DIMENSIONS | MA | MEASUREMENT | SAMPLE | MANFRS DRG/SPEC | FREE FROM BLANKS, CRACKS, WEAVERNESS ETC |
| | | 3. PROOF LOAD TEST (EYE BOLT) | MA | MECH. TEST | -DO- | -DO- | -DO- |
| 1.2 | HARDWARES | 1. SURFACE CONDITION | MA | VISUAL | 100% | - | -DO- |
| | | 2. PROPERTY CLASS | MA | VISUAL | SAMPLES | MANFRS DRG/SPEC BOOK | FREE FROM CRACKS, UN-EVENNESS ETC. |
| 1.3 | CASTING | 1. SURFACE CONDITION | MA | VISUAL | 100% | - | LOG BOOK |
| | | 2. CHEM. & PHY. PROP. | MA | CHEM & MECH TEST | 1 HEAT NO. | MANFRS DRG/SPEC | FREE FROM CRACKS, BLOW HOLES ETC. |
| | | 3. DIMENSIONS | MA | MEASUREMENT | 100% | MANFRS DRG. | RELEVANT SUPPLIERS TC |
| 1.4 | PAIN & VARNISH | 1. MAKE, SHADE, SHELF LIFE & TYPE | MA | VISUAL | 100% | MANFRS DRG/SPEC | LOG BOOK |
| BHEL | | PARTICULARS | | BIDDER/VENDOR | | | |
| | | NAME | | NAME | | | |
| | | SIGNATURE | | SIGNATURE | | | |
| | | DATE | | DATE | | | |
| BIDDER'S/VENDOR'S COMPANY SEAL | | | | | | | |

128

| QUALITY PLAN | | | CUSTOMER | | | PROJECT | | | SPECIFICATION | | |
|--------------|---|---|----------|----------------------|-----------------|-----------------------|--|---------------------|---------------|--------|--|
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTIC | CAT. | TYPE/METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | SECTION | VOLUME | REMARKS |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 1.5 | SHAFT (FORGED OR ROLLED) | 1. SURFACE COND. 2. CHEM. & PHYSICAL PROPERTIES 3. DIMENSIONS 4. INTERNAL FLAWS | MA | VISUAL | 100% | - | FREE FROM VISUAL DEFECTS RELEVANT IS | DO- SUPPLIERS TC | 3 | - | VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED |
| 1.6 | SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, RTDs | 1. MAKE & RATING 2. PHYSICAL COND. 3. DIMENSIONS (WHEREVER APPLICABLE) 4. PERFORMANCE/ CALIBRATION | MA | VISUAL | DO- | MANUFRS. DRG. SPEC. | MANUFRS. DRG. SPEC. | DO- | 3 | - | FOR DIA OF 55 MM & ABOVE |
| | | | MA | MEASUREMENT | 100% | DO- | ASTM-A388 | MANUFRS. DRG. SPEC. | 3 | 2 | |
| | | | MA | TEST | 100% | DO- | NO PHYS. DAMAGE NO ELECTRICAL DISCONTINUITY | DO- | 3 | - | |
| | | | MA | MEASUREMENT | SAMPLE | MANUFRS. DRG. / SPEC. | MANUFRS. DRG. / SPEC. | DO- | 3 | - | |
| | | | MA | INSPECTION REPORT | | DO- | | | 3 | - | |

BIDDER/VENDOR'S COMPANY SEAL

54

55

| | | | | | | | | | | |
|--------------|--|--|------------|-------------------------------|-----------------|--------------------------------|---|---|----------------------|--------------------|
| FORM | | QUALITY PLAN | | CUSTOMER | | PROJECT | | SPECIFICATION | | |
| SHEET 3 OF 8 | | BIDDER/ VENDOR SYSTEM | | TITLE | | NUMBER | | SPECIFICATION | | |
| SL. NO. | COMPONENT/OPERATION | QA/QC CHARACTERISTIC CHECK | QA/QC CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | ITEM ACCEP. REFERENCE DOCUMENT | ACCEP. NORM | FORMAT OF RECORD | TITLE SECTION AGENCY | VOLUME III REMARKS |
| 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 | VISUAL | 100% | - | NO VISUAL DEFECTS | INSPT. REPORT | 3 | 2 |
| 1.8 | SHEET STAMPING (PUNCHED) | 1. SURFACE COND. 2. DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS | MA | TEST VISUAL | SAMPLE 100% | MANUFS SPEC. | MANUFS SPEC. | LOG BOOK AND OR SUPPLIERS TC | 3 | 2 |
| 1.9 | CONDUCTORS | 1. SURFACE FINISH 2. ELECT. PROP. & MECH. PROP. | MA | VISUAL ELECT. & MECH. TEST | 100% | MANUFS SPEC./ RELEVANT IS | NO VISUAL DEFECTS FREE FROM VISUAL DEFECTS | LOG BOOK SUPPLIERS TC & VENDORS INSPN. REPORTS | 3 | 2 |
| BHEL | | PARTICULARS | | BIDDER/VENDOR | | BIDDER'S/VENDOR'S COMPANY SEAL | | | | |
| NAME | | SIGNATURE | | DATE | | | | | | |

5

| SL. NO. | COMPONENT/OPERATION | CUSTOMER | | | PROJECT | | | SPECIFICATION | | | |
|--------------------------------|---|----------------------------|--|--------|--|-------------------------|----------|---------------|------------|---|--|
| | | QUALITY PLAN | | | TITLE | | | NUMBER | | | |
| | | BIDDER/ VENDOR SYSTEM CAT. | | | QUALITY PLAN | | | TITLE | | | |
| | | SHEET 3 OF 9 | | | NUMBER PED-508-00-Q-007 REV-03 | | | SECTION | | | |
| CHARACTERISTIC CHECK | | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) | | | FORMAT OF RECORD | | | VOLUME III | | |
| CHECK | | | EXTENT OF CHECK | | | REFERENCE DOCUMENT | | | AGENCY | | |
| TYPE/ METHOD OF CHECK | | | CHECK | | | NORM | | | P W V | | |
| 4 | | | 5 | | | 6 | | | 7 | | |
| 3 | | | 8 | | | 9 | | | 10 | | |
| 2 | | | 11 | | | | | | | | |
| 1 | IN PROCESS | MA | VISUAL | 100% | -DO- | GOOD FINISH | LOG BOOK | 3/2 | 2 | - | |
| 2.0 | STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR) | MA | MEASUREMENT | -DO- | MANUFS DRG | MANUFS DRG | -DO- | 2 | - | - | |
| 2.1 | 1. WORKMANSHIP & CLEANNESS | MA | VISUAL | 100% | -DO- | GOOD FINISH | LOG BOOK | 2 | - | - | |
| 2.2 | 2. DIMENSIONS | MA | MEASUREMENT | -DO- | MANUFS DRG | MANUFS DRG | -DO- | 2 | - | - | |
| | 1. FINISH | MA | PT | -DO- | RELEVANT SPEC/ ASTM-E165 | MANUFS SPEC/ BHEL SPEC/ | -DO- | 2 | - | 1 | |
| | 2. DIMENSIONS | MA | VISUAL | 100% | MANFRS SPEC/ BHEL SPEC/ SAME AS RELEVANT STAND | LOG BOOK | LOG BOOK | 2 | - | - | |
| 2.3 | 3. SHAFT SURFACE FLOWS | MA | MEASUREMENT BY ELCOMETER | SAMPLE | -DO- | -DO- | -DO- | 2 | - | - | |
| | 1. SURFACE PREPARATION | MA | VISUAL | -DO- | -DO- | -DO- | Log Book | 2 | - | - | |
| | 2. PAINT THICKNESS (BOTH PRIMER & FINISH COAT) | MA | CROSS CUTTING & TAPE TEST | -DO- | -DO- | -DO- | Log Book | 2 | - | - | |
| | 3. SHADE | MA | | | | | | | | | |
| | 4. ADHESION | MA | | | | | | | | | |
| BHEL | | | | | | | | | | | |
| PARTICULARS | | | | | | | | | | | |
| NAME | | | | | | | | | | | |
| SIGNATURE | | | | | | | | | | | |
| DATE | | | | | | | | | | | |
| BIDDER/VENDOR | | | | | | | | | | | |
| BIDDER'S/VENDOR'S COMPANY SEAL | | | | | | | | | | | |

| QUALITY PLAN | | | | | | | | | | SPECIFICATION | |
|---|---|---|---|---|---|---|---|---|----|---------------|--|
| PROJECT TITLE | | | | | | | | | | NUMBER : | |
| BIDDER/ VENDOR SYSTEM | | | | | | | | | | SECTION | |
| SHEET 8 OF 8 | | | | | | | | | | VOLUME III | |
| CHARACTERISTIC CHECK | | | | | | | | | | REMARKS | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| <p>NOTES:</p> <p>1. DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</p> <p>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.</p> <p>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.</p> <p>4. WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>1. AGENT for Inspection Agency</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> | | | | | | | | | | | |

FICHTNER

Volume - V

| 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.

62

| 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 Aluminium 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.

FICHTNER

Volume - V

| 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.

65

FICHTNER

Volume - V

| 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 |

FORMATS-P-REV-B-

| Project | Subject | Tender Doc. No. | Rev | Section |
|---|---|---------------------|-----|-----------|
| RÉPUBLIC 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

(67)

FICHTNER

Volume - V

| 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

V

- Suitable for system with

- Service voltage

- Maximum Conductor Temperature

- Continuous

°C

- Short time

°C

Conductor

- Material

- Size

mm²

Number and diameter of wire in each conductor
no./mm

no./mm

Screening on conductor

- Material

- Type

Thickness

mm

Whether extruded

Yes/No

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 | |

(69)

FICHTNER

Volume - V

| 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 | 70 |

FORM 19.9 REV.0

FICHTNER

Volume - V

| Project | Subject | Tender Doc. No. | Rev | Section |
|---|---|---------------------|-----|-------------------------|
| REPUBLIC OF YEMEN PEC - ME 400 MW MARIß 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.

(71)

FICHTNER

Volume - V

| 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 (Not 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.

73

FICHTNER

Volume - V

| 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.

74

| Project | Subject | Tender Dgc. 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.

(75)

FICHTNER

Volume - V

| 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.

76

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 | 8.15 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

FICHTNER

Volume - V

| 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

78

| 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 fugs | | |
| Make | - | |
| Type | - | |
| * Material | - | |
| Size | mm ² | |
| 8.15.6.9 Fire sealing system | | |

FORM 79-P REV-B

79

126

FICHTNER

Volume - V

| 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.

80

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. 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

81

| 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 tubing 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.

82

| 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.

83

| 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.

84

| 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 |
|---|---|-------------|

85

FICHTNER

Volume - V

| 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

86

| STANDARD QUALITY PLAN | | CUSTOMER : | | PROJECT: | | SPECIFICATION : | | SPECIFICATION | |
|-----------------------|--|---------------------------------|--|--------------------------|--|-----------------|--|---------------|--|
| | | BIDDER/ VENDOR : | | TITLE | | NUMBER : | | TITLE | |
| | | SYSTEM | | ITEM : XLPE Power Cables | | VOLUME III | | REMARKS | |
| | | NUMBER PED-507-QD-Q-001, REV-05 | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

(67)

| STANDARD QUALITY PLAN | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | SPECIFICATION : | |
|-------------------------------|------------------------------|---|----|---|--------|---|---|-------------------------------|-------------------------|
| | | | | | | | | | |
| BIDDER/ VENDOR | | BIDDER/ VENDOR | | BIDDER/ VENDOR | | BIDDER/ VENDOR | | BIDDER/ VENDOR | |
| SYSTEM | | SYSTEM | | SYSTEM | | SYSTEM | | SYSTEM | |
| CAT. | | CAT. | | CAT. | | CAT. | | CAT. | |
| TYPE/ METHOD OF CHECK | | TYPE/ METHOD OF CHECK | | TYPE/ METHOD OF CHECK | | TYPE/ METHOD OF CHECK | | TYPE/ METHOD OF CHECK | |
| EXTENT OF CHECK | | EXTENT OF CHECK | | EXTENT OF CHECK | | EXTENT OF CHECK | | EXTENT OF CHECK | |
| REFERENCE DOCUMENT | | REFERENCE DOCUMENT | | REFERENCE DOCUMENT | | REFERENCE DOCUMENT | | REFERENCE DOCUMENT | |
| ACCEPTANCE NORM | | ACCEPTANCE NORM | | ACCEPTANCE NORM | | ACCEPTANCE NORM | | ACCEPTANCE NORM | |
| FORMAT OF RECORD | | FORMAT OF RECORD | | FORMAT OF RECORD | | FORMAT OF RECORD | | FORMAT OF RECORD | |
| P | | P | | P | | P | | P | |
| W | | W | | W | | W | | W | |
| V | | V | | V | | V | | V | |
| 10 | | 10 | | 10 | | 10 | | 10 | |
| 11 | | 11 | | 11 | | 11 | | 11 | |
| 1.6 | Copper/Aluminium Rods/ Wires | 1. Physical Properties | MA | Physical Tests | -do- | IS-813, IS-5484, IS-8130 & BHEL Specification | IS-813, 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 Sample Visual / Meas. | -do- | 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 | | BIDDER/VENDOR | | BIDDER/VENDOR | |
| NAME | | NAME | | NAME | | NAME | | NAME | |
| SIGNATURE | | SIGNATURE | | SIGNATURE | | SIGNATURE | | SIGNATURE | |
| DATE | | DATE | | DATE | | DATE | | DATE | |
| BIDDER'S/VENDORS COMPANY SEAL | | BIDDER'S/VENDORS COMPANY SEAL | | BIDDER'S/VENDORS COMPANY SEAL | | BIDDER'S/VENDORS COMPANY SEAL | | BIDDER'S/VENDORS COMPANY SEAL | |

88

| STANDARD QUALITY PLAN | | CUSTOMER : | | | PROJECT | | | SPECIFICATION : | | | |
|-----------------------|---|---|----------------------------------|--|--|--|--|---|----------------------------|----------------------------|---|
| BIDDER/ VENDOR | | TITLE | | | NUMBER : | | | SPECIFICATION : | | | |
| SYSTEM | | ITEM XLPE Power Cables | | | TITLE | | | TITLE | | | |
| CAT. | | REFERENCE DOCUMENT | | | ACCEPTANCE NORM | | | FORMAT OF RECORD | | | |
| EXTENT OF CHECK | | TYPE/ METHOD OF CHECK | | | VOLUME III | | | REMARKS | | | |
| P | | W | | | V | | | 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./Appd. Data Sheet/IS:7098 -do- -do- Mfr's Std | -do- Mfr's Std./Appd. data sheet BHEL specn./Appd. Data Sheet/IS:7098 -do- -do- Mfr'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- | Free from bulging burnt particles lumps, cuts & scratches. BHEL Spec./ data sheet BHEL Spec./ data sheet Plant Std. | Log Book -do- -do- -do- | Log Book -do- -do- -do- | 2 2 2 2 | - - - - | N.A. for LT XLPE cables |
| BHEL | | PARTICULARS | | | BIDDER/VENDOR | | | | | | |
| | | NAME | | | SIGNATURE | | | | | | |
| | | DATE | | | | | | | | | |

89


BIDDER'S/VENDOR'S COMPANY SEAL

| STANDARD QUALITY PLAN | | CUSTOMER : | | PROJECT TITLE | | SPECIFICATION : NUMBER : | |
|--|------------------------|--|----|---|---|--|---|
| BIDDER/ VENDOR SYSTEM | | QUALITY PLAN NUMBER PED-507-QD-Q001, REV.05 | | SPECIFICATION : TITLE | | VOLUME III | |
| COMPONENT/OPERATION CHARACTERISTIC CHECK | | EXTENT OF CHECK | | REFERENCE DOCUMENT | | ACCEPTANCE NORM | |
| SHEET 4 OF 5 | | TYPE/ METHOD OF CHECK | | DOCUMENT | | FORMAT OF RECORD | |
| SL. NO. | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 2.6 | Core Laying | 1. Dia over laid up core 2. Sequence of lay. & direction 3. Lay Length | MA | Measurement Visual & Meas. | Sample | Apprd. Data Sheet IS 7098/ Mfrs. Std. | Apprd. Data Sheet IS 7098/ Mfrs. Std. |
| 2.7 | Inner Sheath Extrusion | 1. Surface finish | MA | Meas. Visual | -do- 100% | Mfrs. Std. - | Mfrs. Std. Free from bulging, burnt particles, lumps cuts & scratches. |
| 2.8 | Armour | 2. Sheath thickness 3. Dia over inner sheath 1. No. of wires/Strips | MA | Measurement -do- Counting | Sample -do- At the start of the process | Apprd. Data Sheet, IS:7098 -do- BHEL Specn./ Apprd. Data sheet | Apprd. Data Sheet, IS:7098 -do- BHEL Specn./ Apprd. Data sheet |
| 2.9 | Outer Sheath Extrusion | 2. Lay Direction 3. Lay Length 4. Coverage 5. Dia over armouring 1. Surface Finish | MA | Visual Meas. Measurement Measurement Visual | -do- -do- -do- 100% | IS:7098 Plant Standard BHEL Specn./ Apprd. Data Sheet -do- - | IS:7098 Plant Standard BHEL Specn./ Apprd. Data Sheet -do- - |
| 2.9 | Outer Sheath Extrusion | 2. Sheath thickness 3. Dia over outer sheath 4. Marking | MA | Measurement -do- Visual | Sample -do- 100% | Apprd. Data Sheet -do- IS 7098, BHEL Specn./ Apprd. Data Sheet | Apprd. Data Sheet -do- IS 7098, BHEL Specn./ Apprd. Data Sheet |
| BHEL | | PARTICULARS | | BIDDER/VENDOR | | BIDDER'S/VENDORS COMPANY SEAL | |
| | | NAME | | SIGNATURE | | DATE | |
| | | | | | | | |


90

| STANDARD QUALITY PLAN | | CUSTOMER : | | PROJECT TITLE | | SPECIFICATION : NUMBER : | |
|---------------------------------|--|--|--|---------------------------------|--|---|--|
| BIDDER/ VENDOR SYSTEM | | QUALITY PLAN ITEM XLPE Power Cables | | NUMBER PED-507-QQ-Q-001, REV-05 | | TITLE | |
| SHEET 5 OF 5 | | CHARACTERISTIC CHECK | | EXTENT OF CHECK | | TYPE/ METHOD OF CHECK | |
| COMPONENT/OPERATION | | CAT. | | 4 | | 5 | |
| 1 | | 2 | | 3 | | 4 | |
| 2.10 Finished Cable (INTERNAL) | | 1. Routine Test | | CR | | Elec. & Meas. | |
| 3.0 Final Inspection (EXTERNAL) | | 2. Type Tests (internal) | | CR | | Physical & Electrical Tests | |
| | | 1. Finish & Length | | MA | | Visual, Measurement | |
| | | 2. Dimension | | MA | | Measurement | |
| | | 3. Armouring - Coverage No of Wires/Strips | | MA | | Visual & Meas. | |
| | | 4. Marking & Colour Coding | | MA | | Visual | |
| | | 5. Acceptance Tests | | CR | | Phy. Elec. Tests | |
| | | 6. Type Tests | | CR | | FRLS Tests | |
| | | | | | | Physical & Electrical Tests | |
| | | | | | | Sample * | |
| | | | | | | 100% Sample | |
| | | | | | | IS:7098 & BHEL spec/ Approved Type & acceptance test schedule | |
| | | | | | | Approved Type & acceptance test schedule & approved Data Sheet | |
| | | | | | | Specn./ Appd. Data Sheet/ IS:7098, IS:10810 | |
| | | | | | | Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches | |
| | | | | | | BHEL Specn./ | |
| | | | | | | Test Report | |
| | | | | | | -do- | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | 2 1 - | |
| | | | | | | | |

NOTES:-

| <div></div> | | QUALITY PLAN | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | | |
|--|---|----------------------------------|-----------------------|-----------------------------|--------------------|---|---|----------------------|-------|-----|-------------------------------|
| | | | | BIDDER/ VENDOR | TITLE | NUMBER : | | | | | |
| SHEET 1 OF 5 | | SYSTEM | | QUALITY PLAN | | TITLE | | SPECIFICATION | | | |
| COMPONENT/OPERATION | | CAT. | | TYPE/ METHOD OF CHECK | | EXTENT OF CHECK | | REFERENCE DOCUMENT | | | |
| SL. NO. | CHARACTERISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | SECTION VOLUME III | | | |
| | | | | | | | | AGENCY | 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 | IS-5831/BHEL Specification | IS-5831/BHEL Specification/appd data sheet | Log Book/ Test Cert. | 3/2 - | 2,1 | |
| | | 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 | * Sample from each Batch/Lot. |
| | | 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 | | | | | |

92

|  | | CUSTOMER : | | PROJECT | | SPECIFICATION : | |
|---|--|----------------|--|---------------------------------|--|-----------------|--|
| QUALITY PLAN | | BIDDER/ VENDOR | | TITLE | | NUMBER : | |
| SHEET 2 OF 5 | | SYSTEM | | ITEM :PVC POWER & CONTROL CABLE | | TITLE | |
| COMPONENT/OPERATION | | CAT. | | TYPE/ METHOD OF CHECK | | EXTENT OF CHECK | |
| CHARACTERISTICS CHECK | | 3 | | 4 | | 5 | |
| 1 | | 2 | | 3 | | 4 | |
| 2 | | 3 | | 4 | | 5 | |
| 3 | | 4 | | 5 | | 6 | |
| 4 | | 5 | | 6 | | 7 | |
| 5 | | 6 | | 7 | | 8 | |
| 6 | | 7 | | 8 | | 9 | |
| 7 | | 8 | | 9 | | 10 | |
| 8 | | 9 | | 10 | | 11 | |
| 9 | | 10 | | 11 | | 12 | |
| 10 | | 11 | | 12 | | 13 | |
| 11 | | 12 | | 13 | | 14 | |
| 12 | | 13 | | 14 | | 15 | |
| 13 | | 14 | | 15 | | 16 | |
| 14 | | 15 | | 16 | | 17 | |
| 15 | | 16 | | 17 | | 18 | |
| 16 | | 17 | | 18 | | 19 | |
| 17 | | 18 | | 19 | | 20 | |
| 18 | | 19 | | 20 | | 21 | |
| 19 | | 20 | | 21 | | 22 | |
| 20 | | 21 | | 22 | | 23 | |
| 21 | | 22 | | 23 | | 24 | |
| 22 | | 23 | | 24 | | 25 | |
| 23 | | 24 | | 25 | | 26 | |
| 24 | | 25 | | 26 | | 27 | |
| 25 | | 26 | | 27 | | 28 | |
| 26 | | 27 | | 28 | | 29 | |
| 27 | | 28 | | 29 | | 30 | |
| 28 | | 29 | | 30 | | 31 | |
| 29 | | 30 | | 31 | | 32 | |
| 30 | | 31 | | 32 | | 33 | |
| 31 | | 32 | | 33 | | 34 | |
| 32 | | 33 | | 34 | | 35 | |
| 33 | | 34 | | 35 | | 36 | |
| 34 | | 35 | | 36 | | 37 | |
| 35 | | 36 | | 37 | | 38 | |
| 36 | | 37 | | 38 | | 39 | |
| 37 | | 38 | | 39 | | 40 | |
| 38 | | 39 | | 40 | | 41 | |
| 39 | | 40 | | 41 | | 42 | |
| 40 | | 41 | | 42 | | 43 | |
| 41 | | 42 | | 43 | | 44 | |
| 42 | | 43 | | 44 | | 45 | |
| 43 | | 44 | | 45 | | 46 | |
| 44 | | 45 | | 46 | | 47 | |
| 45 | | 46 | | 47 | | 48 | |
| 46 | | 47 | | 48 | | 49 | |
| 47 | | 48 | | 49 | | 50 | |
| 48 | | 49 | | 50 | | 51 | |
| 49 | | 50 | | 51 | | 52 | |
| 50 | | 51 | | 52 | | 53 | |
| 51 | | 52 | | 53 | | 54 | |
| 52 | | 53 | | 54 | | 55 | |
| 53 | | 54 | | 55 | | 56 | |
| 54 | | 55 | | 56 | | 57 | |
| 55 | | 56 | | 57 | | 58 | |
| 56 | | 57 | | 58 | | 59 | |
| 57 | | 58 | | 59 | | 60 | |
| 58 | | 59 | | 60 | | 61 | |
| 59 | | 60 | | 61 | | 62 | |
| 60 | | 61 | | 62 | | 63 | |
| 61 | | 62 | | 63 | | 64 | |
| 62 | | 63 | | 64 | | 65 | |
| 63 | | 64 | | 65 | | 66 | |
| 64 | | 65 | | 66 | | 67 | |
| 65 | | 66 | | 67 | | 68 | |
| 66 | | 67 | | 68 | | 69 | |
| 67 | | 68 | | 69 | | 70 | |
| 68 | | 69 | | 70 | | 71 | |
| 69 | | 70 | | 71 | | 72 | |
| 70 | | 71 | | 72 | | 73 | |
| 71 | | 72 | | 73 | | 74 | |
| 72 | | 73 | | 74 | | 75 | |
| 73 | | 74 | | 75 | | 76 | |
| 74 | | 75 | | 76 | | 77 | |
| 75 | | 76 | | 77 | | 78 | |
| 76 | | 77 | | 78 | | 79 | |
| 77 | | 78 | | 79 | | 80 | |
| 78 | | 79 | | 80 | | 81 | |
| 79 | | 80 | | 81 | | 82 | |
| 80 | | 81 | | 82 | | 83 | |
| 81 | | 82 | | 83 | | 84 | |
| 82 | | 83 | | 84 | | 85 | |
| 83 | | 84 | | 85 | | 86 | |
| 84 | | 85 | | 86 | | 87 | |
| 85 | | 86 | | 87 | | 88 | |
| 86 | | 87 | | 88 | | 89 | |
| 87 | | 88 | | 89 | | 90 | |
| 88 | | 89 | | 90 | | 91 | |
| 89 | | 90 | | 91 | | 92 | |
| 90 | | 91 | | 92 | | 93 | |
| 91 | | 92 | | 93 | | 94 | |
| 92 | | 93 | | 94 | | 95 | |
| 93 | | 94 | | 95 | | 96 | |
| 94 | | 95 | | 96 | | 97 | |
| 95 | | 96 | | 97 | | 98 | |
| 96 | | 97 | | 98 | | 99 | |
| 97 | | 98 | | 99 | | 100 | |
| 98 | | 99 | | 100 | | 101 | |
| 99 | | 100 | | 101 | | 102 | |
| 100 | | 101 | | 102 | | 103 | |
| 101 | | 102 | | 103 | | 104 | |
| 102 | | 103 | | 104 | | 105 | |
| 103 | | 104 | | 105 | | 106 | |
| 104 | | 105 | | 106 | | 107 | |
| 105 | | 106 | | 107 | | 108 | |
| 106 | | 107 | | 108 | | 109 | |
| 107 | | 108 | | 109 | | 110 | |
| 108 | | 109 | | 110 | | 111 | |
| 109 | | 110 | | 111 | | 112 | |
| 110 | | 111 | | 112 | | 113 | |
| 111 | | 112 | | 113 | | 114 | |
| 112 | | 113 | | 114 | | 115 | |
| 113 | | 114 | | 115 | | 116 | |
| 114 | | 115 | | 116 | | 117 | |
| 115 | | 116 | | 117 | | 118 | |
| 116 | | 117 | | 118 | | 119 | |
| 117 | | 118 | | 119 | | 120 | |
| 118 | | 119 | | 120 | | 121 | |
| 119 | | 120 | | 121 | | 122 | |
| 120 | | 121 | | 122 | | 123 | |
| 121 | | 122 | | 123 | | 124 | |
| 122 | | 123 | | 124 | | 125 | |
| 123 | | 124 | | 125 | | 126 | |
| 124 | | 125 | | 126 | | 127 | |
| 125 | | 126 | | 127 | | 128 | |
| 126 | | 127 | | 128 | | 129 | |
| 127 | | 128 | | 129 | | 130 | |
| 128 | | 129 | | 130 | | 131 | |
| 129 | | 130 | | 131 | | 132 | |
| 130 | | 131 | | 132 | | 133 | |
| 131 | | 132 | | 133 | | 134 | |
| 132 | | 133 | | 134 | | 135 | |
| 133 | | 134 | | 135 | | 136 | |
| 134 | | 135 | | 136 | | 137 | |
| 135 | | 136 | | 137 | | 138 | |
| 136 | | 137 | | 138 | | 139 | |
| 137 | | 138 | | 139 | | 140 | |
| 138 | | 139 | | 140 | | 141 | |
| 139 | | 140 | | 141 | | 142 | |
| 140 | | 141 | | 142 | | 143 | |
| 141 | | 142 | | 143 | | 144 | |
| 142 | | 143 | | 144 | | 145 | |
| 143 | | 144 | | 145 | | 146 | |
| 144 | | 145 | | 146 | | 147 | |
| 145 | | 146 | | 147 | | 148 | |
| 146 | | 147 | | 148 | | 149 | |
| 147 | | 148 | | 149 | | 150 | |
| 148 | | 149 | | 150 | | 151 | |
| 149 | | 150 | | 151 | | 152 | |
| 150 | | 151 | | 152 | | 153 | |
| 151 | | 152 | | 153 | | 154 | |
| 152 | | 153 | | 154 | | 155 | |
| 153 | | 154 | | 155 | | 156 | |
| 154 | | 155 | | 156 | | 157 | |
| 155 | | 156 | | 157 | | 158 | |
| 156 | | 157 | | 158 | | 159 | |
| 157 | | 158 | | 159 | | 160 | |
| 158 | | 159 | | 160 | | 161 | |
| 159 | | 160 | | 161 | | 162 | |
| 160 | | 161 | | 162 | | 163 | |
| 161 | | 162 | | 163 | | 164 | |
| 162 | | 163 | | 164 | | 165 | |
| 163 | | 164 | | 165 | | 166 | |
| 164 | | 165 | | 166 | | 167 | |
| 165 | | 166 | | 167 | | 168 | |
| 166 | | 167 | | 168 | | 169 | |
| 167 | | 168 | | 169 | | 170 | |
| 168 | | 169 | | 170 | | 171 | |
| 169 | | 170 | | 171 | | 172 | |
| 170 | | 171 | | 172 | | 173 | |
| 171 | | 172 | | 173 | | 174 | |
| 172 | | 173 | | 174 | | 175 | |
| 173 | | 174 | | 175 | | 176 | |
| 174 | | 175 | | 176 | | 177 | |
| 175 | | 176 | | 177 | | 178 | |
| 176 | | 177 | | 178 | | 179 | |
| 177 | | 178 | | 179 | | 180 | |
| 178 | | 179 | | 180 | | 181 | |
| 179 | | 180 | | 181 | | 182 | |
| 180 | | 181 | | 182 | | 183 | |
| 181 | | 182 | | 183 | | 184 | |
| 182 | | 183 | | 184 | | 185 | |
| 183 | | 184 | | 185 | | 186 | |
| 184 | | 185 | | 186 | | 187 | |
| 185 | | 186 | | 187 | | 188 | |
| 186 | | 187 | | 188 | | 189 | |
| 187 | | 188 | | 189 | | 190 | |
| 188 | | 189 | | 190 | | 191 | |
| 189 | | 190 | | 191 | | 192 | |
| 190 | | 191 | | 192 | | 193 | |
| 191 | | 192 | | 193 | | 194 | |
| 192 | | 193 | | 194 | | 195 | |
| 193 | | 194 | | 195 | | 196 | |
| 194 | | 195 | | 196 | | 197 | |
| 195 | | 196 | | 197 | | 198 | |
| 196 | | 197 | | 198 | | 199 | |
| 197 | | 198 | | 199 | | 200 | |
| 198 | | 199 | | 200 | | 201 | |
| 199 | | 200 | | 201 | | 202 | |
| 200 | | 201 | | 202 | | 203 | |
| 201 | | 202 | | 203 | | 204 | |
| 202 | | 203 | | 204 | | 205 | |
| 203 | | 204 | | 205 | | 206 | |
| 204 | | 205 | | 206 | | 207 | |
| 205 | | 206 | | 207 | | 208 | |
| 206 | | 207 | | 208 | | 209 | |
| 207 | | 208 | | 209 | | 210 | |
| 208 | | 209 | | 210 | | 211 | |
| 209 | | 210 | | 211 | | 212 | |
| 210 | | 211 | | 212 | | 213 | |
| 211 | | 212 | | 213 | | 214 | |
| 212 | | 213 | | 214 | | 215 | |
| 213 | | 214 | | 215 | | 216 | |
| 214 | | 215 | | 216 | | 217 | |
| 215 | | 216 | | 217 | | 218 | |
| 216 | | 217 | | 218 | | 219 | |
| 217 | | 218 | | 219 | | 220 | |
| 218 | | 219 | | 220 | | 221 | |
| 219 | | 220 | | 221 | | 222 | |
| 220 | | 221 | | 222 | | 223 | |
| 221 | | 222 | | 223 | | 224 | |
| 222 | | 223 | | 224 | | 225 | |
| 223 | | 224 | | 225 | | 226 | |
| 224 | | 225 | | 226 | | 227 | |
| 225 | | 226 | | 227 | | 228 | |
| 226 | | 227 | | 228 | | 229 | |
| 227 | | 228 | | 229 | | 230 | |
| 228 | | 229 | | 230 | | 231 | |
| 229 | | 230 | | 231 | | 232 | |
| 230 | | 231 | | 232 | | 233 | |
| 231 | | 232 | | 233 | | 234 | |
| 232 | | 233 | | 234 | | 235 | |
| 233 | | 234 | | 235 | | 236 | |
| 234 | | 235 | | 236 | | 237 | |
| 235 | | 236 | | 237 | | 238 | |
| 236 | | 237 | | 238 | | 239 | |
| 237 | | 238 | | 239 | | 240 | |
| 238 | | 239 | | 240 | | 241 | |
| 239 | | 240 | | 241 | | 242 | |
| 240 | | 241 | | 242 | | 243 | |
| 241 | | 242 | | 243 | | 244 | |
| 242 | | 243 | | 244 | | 245 | |
| 243 | | 244 | | 245 | | 246 | |
| 244 | | 245 | | 246 | | 247 | |
| 245 | | 246 | | 247 | | 248 | |
| 246 | | 247 | | 248 | | 249 | |
| 247 | | 248 | | 249 | | 250 | |
| 248 | | 249 | | 250 | | 251 | |
| 249 | | 250 | | 251 | | 252 | |
| 250 | | 251 | | 252 | | 253 | |
| 251 | | 252 | | 253 | | 254 | |
| 252 | | 253 | | 254 | | 255 | |
| 253 | | 254 | | 255 | | 256 | |
| 254 | | 255 | | 256 | | 257 | |
| 255 | | 256 | | 257 | | 258 | |
| 256 | | 257 | | 258 | | 259 | |
| 257 | | 258 | | 259 | | 260 | |
| 258 | | 259 | | 260 | | 261 | |
| 259 | | 260 | | 261 | | 262 | |
| 260 | | 261 | | 262 | | 263 | |
| 261 | | 262 | | 263 | | 264 | |
| 262</ | | | | | | | |

| CUSTOMER : | | PROJECT | | SPECIFICATION : | | | | | | | | |
|-------------------------------|------------------------|---------------------------------|------|-----------------------|-----------------------------|---|--|------------------|--------|---|---|---|
| BIDDER/ VENDOR | | TITLE | | NUMBER : | | | | | | | | |
| QUALITY PLAN | | QUALITY PLAN | | SPECIFICATION : | | | | | | | | |
| SHEET 4 OF 5 | | 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 | - | - | |
| 2.8 | Finished Cable | 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 | - | - | Sequential marking shall be done by printing |
| | | 1. Routine Test | CR | Elec. & Meas. | 100% | IS-1554 & BHEL Specn. | IS-1554 & BHEL Specn. | Test Report | 2 | - | 1 | Vendor's internal testing |
| 3.0 | Final Inspection | 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 | One drum each for Power & control cables in a Lot |
| | | 1. Finish & Length | MA | Visual | (See remark) | BHEL specn. IS-1554 | Free from Porosity, Bulging,Burnt particles, lumps, cuts & scratches | Test Report | 2 | 1 | - | |
| BIDDER/VENDOR | | | | | | | | | | | | |
| PARTICULARS | | | | | | | | | | | | |
| BHEL | | | | | | | | | | | | |
| NAME | | | | | | | | | | | | |
| SIGNATURE | | | | | | | | | | | | |
| DATE | | | | | | | | | | | | |
| BIDDER'S/VENDORS COMPANY SEAL | | | | | | | | | | | | |

95

| CUSTOMER : | | PROJECT | | SPECIFICATION : | | | | | | |
|---|---------------------|--|----|------------------------|--------------|-------------------------------------|-------------------------------------|-------------|----|----|
| BIDDER/ VENDOR | | TITLE | | NUMBER : | | | | | | |
| SYSTEM | | QUALITY PLAN | | TITLE | | | | | | |
| CAT. | | REFERENCE DOCUMENT | | SECTION | | | | | | |
| TYPE/ METHOD OF CHECK | | ACCEPTANCE NORM | | AGENCY | | | | | | |
| EXTENT OF CHECK | | FORMAT OF RECORD | | REMARKS | | | | | | |
| CAT. | | 7 | | 10 | | | | | | |
| 3 | | 8 | | 11 | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | | | | | | | | |
| | | | MA | Measurement | As per IS | Appd.Data Sheet/ IS-1554 & IS-10810 | Appd.Data Sheet/ IS-1554 & IS-10810 | Test Report | 2 | 1 |
| | | 2. Dimension | MA | Visual & Meas. | As per IS | -do- | -do- | -do- | 2 | 1 |
| | | 3. Armouring - Coverage No. of Wires/Srips | MA | Visual | -do- | -do- | -do- | -do- | 2 | 1 |
| | | 4. Marking/Colour Coding | MA | Phy & Elect. Tests | As per IS | -do- | -do- | -do- | 2 | 1 |
| | | 5. Acceptance Tests | CR | FRLS Tests Measurement | (SEE REMARK) | BHEL Specn. Apprd.Data Sheet | BHEL Specn. Apprd.Data Sheet | -do- | 2 | 1 |
| | | 6. Type & FRLS Tests | CR | | | | | | 2 | 1 |
| <p>NOTES:-</p> <p>(A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME.</p> <p>(B) NO REPAIR OF CORE INSULATION PERMITTED</p> <p>(C) CABLE ENDS SHALL BE SEALED AS PER VENDOR'S SPECIFICATION.</p> <p>(D) PURCHASER SHALL HAVE RIGHT TO WITNESS THE SPARK TEST AT CORE STAGE</p> <p>(E) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.</p> <p>(F) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET</p> <p>(G) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS 'SAMPLE' & NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN.</p> <p>(H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER IS/BHEL SPECIFICATION.</p> <p>LEGEND : P : PERFORMER V: VERIFIER 1- BHEL 2-VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE.</p> | | | | | | | | | | |
| <p>BHEL</p> <p>PARTICULARS</p> <p>NAME</p> <p>SIGNATURE</p> <p>DATE</p> | | | | | | | | | | |
| BIDDER'S/VENDORS COMPANY SEAL | | | | | | | | | | |

| CUSTOMER : | | PROJECT : | | SPECIFICATION : | | | | | | | | |
|---|--|-----------------------------------|----|-----------------------------|---------|---|----------------------|-----|---|---|--|--|
| BIDDER/ VENDOR : | | TITLE : | | NUMBER : | | | | | | | | |
| SYSTEM : | | QUALITY PLAN : | | SPECIFICATION : | | | | | | | | |
| CAT. | | ITEM/INSTRUMENTATION CABLES : | | TITLE : | | | | | | | | |
| SHEET 1 OF 5 | | NUMBER PED-507-00-Q-004 REV.02 | | VOLUME III | | | | | | | | |
| COMPONENT/OPERATION CHARACTERISTICS CHECK | | ACCEPTANCE NORM | | REMARKS | | | | | | | | |
| SL. NO. | | EXTENT OF CHECK | | FORMAT OF RECORD | | | | | | | | |
| 2 | | 3 | | 4 | | | | | | | | |
| 1 | | 5 | | 6 | | | | | | | | |
| 7 | | 8 | | 9 | | | | | | | | |
| 10 | | 11 | | 12 | | | | | | | | |
| 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 | Log Book/ Test Cert. | 3/2 | - | 2 | | |
| | | 2. Elec. Properties (Insulation) | MA | Electrical Tests | Sample | -do- | -do- | 3/2 | - | 2 | | |
| | | 3. FRLS Properties (outer sheath) | CR | Environmental | Sample | -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 | -do- | 3/2 | - | 2 | | * Sample from each Batch/Lot as per IS-3975 Annexure-A |
| | | 2. Dimension | MA | Measurement | -do- | -do- | -do- | 3/2 | - | 2 | | |
| | | 3. Galvanization Quality | MA | Galv. Tests | -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 | -do- | 3/2 | - | 2 | | |
| | | 2. Electrical properties | CR | Electrical Tests | -do- | -do- | -do- | 3/2 | - | 2 | | |
| 1.4 | Fillers | 1. FRLS Properties | CR | Chemical/ Environ. test | -do- | -do- | -do- | 3/2 | - | 2 | | |
| 1.5 | Screen | 1. Dimension | MA | Measurement | -do- | Appd. Data Sheet | TC & IR | 3/2 | - | 2 | | |
| BHEL | | PARTICULARS | | BIDDER/VENDOR | | | | | | | | |
| | | NAME | | SIGNATURE | | | | | | | | |
| | | DATE | | DATE | | | | | | | | |

| QUALITY PLAN | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | | | |
|----------------------|---------------------------------------|---|----|----------------------------------|--------|---|--|----------|-----|----|
| BIDDER/ VENDOR | | TITLE | | NUMBER : | | SPECIFICATION : | | | | |
| SYSTEM | | ITEM INSTRUMENTATION CABLES | | SECTION | | VOLUME III | | | | |
| CAT. | | REFERENCE DOCUMENT | | ACCEPTANCE NORM | | FORMAT OF RECORD | | | | |
| TYPE/METHOD OF CHECK | | EXTENT OF CHECK | | P | | W V | | | | |
| CAT. | | 4 | | 5 | | 6 | | | | |
| 3 | | 7 | | 8 | | 9 | | | | |
| 10 | | 11 | | 12 | | 13 | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 2.0 | IN PROCESS | 2. Mech. Prop. | MA | Mech test | -do- | MFRS. STD. | MFRS. STD. | TC & IR | 3/2 | 2 |
| 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 | - |
| BHEL | | PARTICULARS | | BIDDER/VENDOR | | BIDDER'S/VENDORS COMPANY SEAL | | | | |
| | | NAME | | | | | | | | |
| | | SIGNATURE | | | | | | | | |
| | | DATE | | | | | | | | |

98

| CUSTOMER : | | PROJECT TITLE | | SPECIFICATION : NUMBER : | |
|---|--|-----------------------------|--|--------------------------|--|
| BIDDER/ VENDOR SYSTEM CAT. | | QUALITY PLAN SHEET 3 OF 5 | | SPECIFICATION : TITLE | |
| COMPONENT/OPERATION CHARACTERISTICS CHECK | | ITEM INSTRUMENTATION CABLES | | VOLUME III | |
| SL. NO. | | EXTENT OF CHECK | | REMARKS | |
| 1 | | 2 | | 3 | |
| 2 | | 3 | | 4 | |
| 3 | | 4 | | 5 | |
| 4 | | 5 | | 6 | |
| 5 | | 6 | | 7 | |
| 6 | | 7 | | 8 | |
| 7 | | 8 | | 9 | |
| 8 | | 9 | | 10 | |
| 9 | | 10 | | 11 | |
| 10 | | 11 | | 12 | |
| 11 | | 12 | | 13 | |
| 12 | | 13 | | 14 | |
| 13 | | 14 | | 15 | |
| 14 | | 15 | | 16 | |
| 15 | | 16 | | 17 | |
| 16 | | 17 | | 18 | |
| 17 | | 18 | | 19 | |
| 18 | | 19 | | 20 | |
| 19 | | 20 | | 21 | |
| 20 | | 21 | | 22 | |
| 21 | | 22 | | 23 | |
| 22 | | 23 | | 24 | |
| 23 | | 24 | | 25 | |
| 24 | | 25 | | 26 | |
| 25 | | 26 | | 27 | |
| 26 | | 27 | | 28 | |
| 27 | | 28 | | 29 | |
| 28 | | 29 | | 30 | |
| 29 | | 30 | | 31 | |
| 30 | | 31 | | 32 | |
| 31 | | 32 | | 33 | |
| 32 | | 33 | | 34 | |
| 33 | | 34 | | 35 | |
| 34 | | 35 | | 36 | |
| 35 | | 36 | | 37 | |
| 36 | | 37 | | 38 | |
| 37 | | 38 | | 39 | |
| 38 | | 39 | | 40 | |
| 39 | | 40 | | 41 | |
| 40 | | 41 | | 42 | |
| 41 | | 42 | | 43 | |
| 42 | | 43 | | 44 | |
| 43 | | 44 | | 45 | |
| 44 | | 45 | | 46 | |
| 45 | | 46 | | 47 | |
| 46 | | 47 | | 48 | |
| 47 | | 48 | | 49 | |
| 48 | | 49 | | 50 | |
| 49 | | 50 | | 51 | |
| 50 | | 51 | | 52 | |
| 51 | | 52 | | 53 | |
| 52 | | 53 | | 54 | |
| 53 | | 54 | | 55 | |
| 54 | | 55 | | 56 | |
| 55 | | 56 | | 57 | |
| 56 | | 57 | | 58 | |
| 57 | | 58 | | 59 | |
| 58 | | 59 | | 60 | |
| 59 | | 60 | | 61 | |
| 60 | | 61 | | 62 | |
| 61 | | 62 | | 63 | |
| 62 | | 63 | | 64 | |
| 63 | | 64 | | 65 | |
| 64 | | 65 | | 66 | |
| 65 | | 66 | | 67 | |
| 66 | | 67 | | 68 | |
| 67 | | 68 | | 69 | |
| 68 | | 69 | | 70 | |
| 69 | | 70 | | 71 | |
| 70 | | 71 | | 72 | |
| 71 | | 72 | | 73 | |
| 72 | | 73 | | 74 | |
| 73 | | 74 | | 75 | |
| 74 | | 75 | | 76 | |
| 75 | | 76 | | 77 | |
| 76 | | 77 | | 78 | |
| 77 | | 78 | | 79 | |
| 78 | | 79 | | 80 | |
| 79 | | 80 | | 81 | |
| 80 | | 81 | | 82 | |
| 81 | | 82 | | 83 | |
| 82 | | 83 | | 84 | |
| 83 | | 84 | | 85 | |
| 84 | | 85 | | 86 | |
| 85 | | 86 | | 87 | |
| 86 | | 87 | | 88 | |
| 87 | | 88 | | 89 | |
| 88 | | 89 | | 90 | |
| 89 | | 90 | | 91 | |
| 90 | | 91 | | 92 | |
| 91 | | 92 | | 93 | |
| 92 | | 93 | | 94 | |
| 93 | | 94 | | 95 | |
| 94 | | 95 | | 96 | |
| 95 | | 96 | | 97 | |
| 96 | | 97 | | 98 | |
| 97 | | 98 | | 99 | |
| 98 | | 99 | | 100 | |
| 99 | | 100 | | 101 | |
| 100 | | 101 | | 102 | |
| 101 | | 102 | | 103 | |
| 102 | | 103 | | 104 | |
| 103 | | 104 | | 105 | |
| 104 | | 105 | | 106 | |
| 105 | | 106 | | 107 | |
| 106 | | 107 | | 108 | |
| 107 | | 108 | | 109 | |
| 108 | | 109 | | 110 | |
| 109 | | 110 | | 111 | |
| 110 | | 111 | | 112 | |
| 111 | | 112 | | 113 | |
| 112 | | 113 | | 114 | |
| 113 | | 114 | | 115 | |
| 114 | | 115 | | 116 | |
| 115 | | 116 | | 117 | |
| 116 | | 117 | | 118 | |
| 117 | | 118 | | 119 | |
| 118 | | 119 | | 120 | |
| 119 | | 120 | | 121 | |
| 120 | | 121 | | 122 | |
| 121 | | 122 | | 123 | |
| 122 | | 123 | | 124 | |
| 123 | | 124 | | 125 | |
| 124 | | 125 | | 126 | |
| 125 | | 126 | | 127 | |
| 126 | | 127 | | 128 | |
| 127 | | 128 | | 129 | |
| 128 | | 129 | | 130 | |
| 129 | | 130 | | 131 | |
| 130 | | 131 | | 132 | |
| 131 | | 132 | | 133 | |
| 132 | | 133 | | 134 | |
| 133 | | 134 | | 135 | |
| 134 | | 135 | | 136 | |
| 135 | | 136 | | 137 | |
| 136 | | 137 | | 138 | |
| 137 | | 138 | | 139 | |
| 138 | | 139 | | 140 | |
| 139 | | 140 | | 141 | |
| 140 | | 141 | | 142 | |
| 141 | | 142 | | 143 | |
| 142 | | 143 | | 144 | |
| 143 | | 144 | | 145 | |
| 144 | | 145 | | 146 | |
| 145 | | 146 | | 147 | |
| 146 | | 147 | | 148 | |
| 147 | | 148 | | 149 | |
| 148 | | 149 | | 150 | |
| 149 | | 150 | | 151 | |
| 150 | | 151 | | 152 | |
| 151 | | 152 | | 153 | |
| 152 | | 153 | | 154 | |
| 153 | | 154 | | 155 | |
| 154 | | 155 | | 156 | |
| 155 | | 156 | | 157 | |
| 156 | | 157 | | 158 | |
| 157 | | 158 | | 159 | |
| 158 | | 159 | | 160 | |
| 159 | | 160 | | 161 | |
| 160 | | 161 | | 162 | |
| 161 | | 162 | | 163 | |
| 162 | | 163 | | 164 | |
| 163 | | 164 | | 165 | |
| 164 | | 165 | | 166 | |
| 165 | | 166 | | 167 | |
| 166 | | 167 | | 168 | |
| 167 | | 168 | | 169 | |
| 168 | | 169 | | 170 | |
| 169 | | 170 | | 171 | |
| 170 | | 171 | | 172 | |
| 171 | | 172 | | 173 | |
| 172 | | 173 | | 174 | |
| 173 | | 174 | | 175 | |
| 174 | | 175 | | 176 | |
| 175 | | 176 | | 177 | |
| 176 | | 177 | | 178 | |
| 177 | | 178 | | 179 | |
| 178 | | 179 | | 180 | |
| 179 | | 180 | | 181 | |
| 180 | | 181 | | 182 | |
| 181 | | 182 | | 183 | |
| 182 | | 183 | | 184 | |
| 183 | | 184 | | 185 | |
| 184 | | 185 | | 186 | |
| 185 | | 186 | | 187 | |
| 186 | | 187 | | 188 | |
| 187 | | 188 | | 189 | |
| 188 | | 189 | | 190 | |
| 189 | | 190 | | 191 | |
| 190 | | 191 | | 192 | |
| 191 | | 192 | | 193 | |
| 192 | | 193 | | 194 | |
| 193 | | 194 | | 195 | |
| 194 | | 195 | | 196 | |
| 195 | | 196 | | 197 | |
| 196 | | 197 | | 198 | |
| 197 | | 198 | | 199 | |
| 198 | | 199 | | 200 | |
| 199 | | 200 | | 201 | |
| 200 | | 201 | | 202 | |
| 201 | | 202 | | 203 | |
| 202 | | 203 | | 204 | |
| 203 | | 204 | | 205 | |
| 204 | | 205 | | 206 | |
| 205 | | 206 | | 207 | |
| 206 | | 207 | | 208 | |
| 207 | | 208 | | 209 | |
| 208 | | 209 | | 210 | |
| 209 | | 210 | | 211 | |
| 210 | | 211 | | 212 | |
| 211 | | 212 | | 213 | |
| 212 | | 213 | | 214 | |
| 213 | | 214 | | 215 | |
| 214 | | 215 | | 216 | |
| 215 | | 216 | | 217 | |
| 216 | | 217 | | 218 | |
| 217 | | 218 | | 219 | |
| 218 | | 219 | | 220 | |
| 219 | | 220 | | 221 | |
| 220 | | 221 | | 222 | |
| 221 | | 222 | | 223 | |
| 222 | | 223 | | 224 | |
| 223 | | 224 | | 225 | |
| 224 | | 225 | | 226 | |
| 225 | | 226 | | 227 | |
| 226 | | 227 | | 228 | |
| 227 | | 228 | | 229 | |
| 228 | | 229 | | 230 | |
| 229 | | 230 | | 231 | |
| 230 | | 231 | | 232 | |
| 231 | | 232 | | 233 | |
| 232 | | 233 | | 234 | |
| 233 | | 234 | | 235 | |
| 234 | | 235 | | 236 | |
| 235 | | 236 | | 237 | |
| 236 | | 237 | | 238 | |
| 237 | | 238 | | 239 | |
| 238 | | 239 | | 240 | |
| 239 | | 240 | | 241 | |
| 240 | | 241 | | 242 | |
| 241 | | 242 | | 243 | |
| 242 | | 243 | | 244 | |
| 243 | | 244 | | 245 | |
| 244 | | 245 | | 246 | |
| 245 | | 246 | | 247 | |
| 246 | | 247 | | 248 | |
| 247 | | 248 | | 249 | |
| 248 | | 249 | | 250 | |
| 249 | | 250 | | 251 | |
| 250 | | 251 | | 252 | |
| 251 | | 252 | | 253 | |
| 252 | | 253 | | 254 | |
| 253 | | 254 | | 255 | |
| 254 | | 255 | | 256 | |
| 255 | | 256 | | 257 | |
| 256 | | 257 | | 258 | |
| 257 | | 258 | | 259 | |
| 258 | | 259 | | 260 | |
| 259 | | 260 | | 261 | |
| 260 | | 261 | | 262 | |
| 261 | | 262 | | 263 | |
| 262 | | 263 | | 264 | |
| 263 | | 264 | | 265 | |
| 264 | | 265 | | 266 | |
| 265 | | 266 | | 267 | |
| 266 | | 267 | | 268 | |
| 267 | | 268 | | 269 | |
| 268 | | 269 | | 270 | |
| 269 | | 270 | | 271 | |
| 270 | | 271 | | 272 | |
| 271 | | 272 | | 273 | |
| 272 | | 273 | | 274 | |
| 273 | | 274 | | 275 | |
| 274 | | 275 | | 276 | |
| 275 | | 276 | | 277 | |
| 276 | | 277 | | 278 | |
| 277 | | 278 | | 279 | |
| 278 | | 279 | | 280 | |
| 279 | | 280 | | 281 | |
| 280 | | 281 | | 282 | |
| 281 | | 282 | | 283 | |
| 282 | | 283 | | 284 | |
| 283 | | 284 | | 285 | |
| 284 | | 285 | | 286 | |
| 285 | | 286 | | 287 | |
| 286 | | 287 | | 288 | |
| 287 | | 288 | | 289 | |
| 288 | | 289 | | 290 | |
| 289 | | 290 | | 291 | |
| 290 | | 291 | | 292 | |
| 291 | | 292 | | 293 | |
| 292 | | 293 | | 294 | |
| 293 | | 294 | | 295 | |
| 294 | | 295 | | 296 | |
| 295 | | 296 | | 297 | |
| 296 | | 297 | | 298 | |
| 297 | | 298 | | 299 | |
| 298 | | 299 | | 300 | |
| 299 | | 300 | | 301 | |
| 300 | | 301 | | 302 | |
| 301 | | 302 | | 303 | |
| 302 | | 303 | | 304 | |
| 303 | | 304 | | 305 | |
| 304 | | 305 | | 306 | |
| 305 | | 306 | | 307 | |
| 306 | | 307 | | 308 | |
| 307 | | 308 | | 309 | |
| 308 | | 309 | | 310 | |
| 309 | | 310 | | 311 | |
| 310 | | 311 | | 312 | |
| 311 | | 312 | | 313 | |
| 312 | | 313 | | 314 | |
| 313 | | 314 | | 315 | |
| 314 | | 315 | | 316 | |
| 315 | | 316 | | 317 | |
| 316 | | 317 | | 318 | |
| 317 | | 318 | | 319 | |
| 318 | | 319 | | 320 | |
| 319 | | 320 | | 321 | |
| 320 | | 321 | | 322 | |
| 321 | | 322 | | 323 | |
| 322 | | 323 | | 324 | |
| 323 | | 324 | | 325 | |
| 324 | | 325 | | 326 | |
| 325 | | 326 | | 327 | |
| 326 | | 327 | | 328 | |
| 327 | | 328 | | 329 | |
| 328 | | 329 | | 330 | |
| 329 | | 330 | | 331 | |
| 330 | | 331 | | 332 | |
| 331 | | 332 | | 333 | |
| 332 | | 333 | | 334 | |
| 333 | | 334 | | 335 | |
| 334 | | 335 | | 336 | |
| 335 | | 336 | | 337 | |
| 336 | | 337 | | 338 | |
| 337 | | 338 | | 339 | |
| 338 | | 339 | | 340 | |
| 339 | | 340 | | | |

| CUSTOMER : | | PROJECT : | | SPECIFICATION : | | | | | | | | | |
|----------------|------------------------|-------------------------------|-----------------------|-------------------|-----------------------------|---|---|----------------|----|----|---|--|--|
| BIDDER/ VENDOR | | TITLE | | NUMBER : | | | | | | | | | |
| SYSTEM CAT. | | QUALITY PLAN | | SPECIFICATION : | | | | | | | | | |
| SHEET 4 OF 5 | | NUMBER PED-507-Q-004, REV.02 | | TITLE | | | | | | | | | |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | SECTION AGENCY | P | W | V | VOLUME III REMARKS | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | | 3. Dia over inner sheath | MA | Measurement | Sample | BHEL Spec. & appd. Data sheet | BHEL Spec. & appd. Data sheet | -do- | 2 | - | - | | |
| 2.6 | Armouring | 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 | - | - | | |
| 2.7 | Outer Sheath Extrusion | 5. Dia over armouring | MA | Measurement | -do- | -do- | -do- | -do- | 2 | - | - | | |
| | | 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 | |
| BHEL | | PARTICULARS | | BIDDER/VENDOR | | | | | | | | | |
| | | NAME | | | | | | | | | | | |
| | | SIGNATURE | | | | | | | | | | | |
| | | DATE | | | | | | | | | | | |
| | | BIDDER'S/VENDORS COMPANY SEAL | | | | | | | | | | | |

| BHEL | | QUALITY PLAN | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | | |
|--|------------------|---|----|---------------------------------|----------------|---|---|-----------------|----|----|--|
| BHEL | | BIDDER/ VENDOR | | TITLE | | NUMBER : | | TITLE | | | |
| BHEL | | SYSTEM | | NUMBER PED-507-00-Q-004, REV.02 | | SECTION | | VOLUME III | | | |
| BHEL | | CAT. | | REFERENCE DOCUMENT | | ACCEPTANCE | | REMARKS | | | |
| BHEL | | TYPE/ METHOD OF CHECK | | EXTENT OF CHECK | | FORMAT OF RECORD | | P W V | | | |
| BHEL | | CHECK | | CHECK | | NORM | | P W V | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 3.0 | Final Inspection | 1. Finish & Length | 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 |
| | | 2. Dimensions | MA | Measurement | Sample Lengths | BHEL Specn./Appd. Data sheet | BHEL Specn./Appd. Data sheet/ test procedures | Test Report | 2 | 1 | |
| | | 3. Armouring - Coverage No. of Wires/Strips | MA | Visual & Meas. | Sample | -do- | -do- | -do- | 2 | 1 | |
| | | 4. Marking/Colour/ pair Identification | MA | Visual | -do- | -do- | -do- | -do- | 2 | 1 | |
| | | 5. Test for screening | CR | Elect. Test | -do- | test procedures/ | test procedures | -do- | 2 | 1 | |
| | | 6. Acceptance Tests | 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. |
| | | 7. Type & FRLS Tests | 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) per lot. 2. Flammability tests: one sample only. |
| <p>NOTES:-</p> <p>(A) JOINTS IN WIRE SHALL BE AS PERMITTED BY REL STD / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME.</p> <p>(B) NO REPAIR OF CORE INSULATION PERMITTED</p> <p>(C) CABLE ENDS SHALL BE SEALED AS PER REL. STD./ BHEL SPECIFICATION</p> <p>(D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.</p> <p>(E) FILLERS/DUMMIES CORES ETC. SHALL BE AS PER BHEL SPECIFICATION</p> <p>(F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN OP. THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER</p> <p>(H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY/ CONFIRMING THE PACKING AS PER REL. STD./ BHEL SPECIFICATION.</p> <p>(I) TICK APPLICABLE STANDARD W.R.T TO CONTRACTUAL REQUIREMENTS VDE/IS /IEC.</p> | | | | | | | | | | | |
| <p>LEGEND : P : PERFORMER W: WITNESS V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3 SUB VENDOR CHP: CUSTOMER HOLD POINT</p> | | | | | | | | | | | |
| <p>BHEL</p> | | | | | | | | | | | |
| <p>PARTICULARS</p> | | | | | | | | | | | |
| <p>NAME</p> | | | | | | | | | | | |
| <p>SIGNATURE</p> | | | | | | | | | | | |
| <p>DATE</p> | | | | | | | | | | | |
| <p>BIDDER'S/VENDORS COMPANY SEAL</p> | | | | | | | | | | | |

101



TITLE

COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

SECTION-C4

TECHNICAL SPECIFICATION (C&I PORTION)

103

4 X 100MW MARIB-II GTPS

**Technical Specifications (C&I)
for Mechanical Auxiliaries Packages**

Table of Contents

1. Notes
2. Control philosophy for mechanical auxiliary packages
3. Technical specifications, data sheet and quality plan for PLC & PLC configuration diagram
4. Technical specifications and quality plans for instruments, flow elements and control valve
5. Technical specifications, quality plan and data sheet for LCP
6. Data sheet and wiring diagram for motorized valve actuator
7. KKS philosophy

105

Notes:

1. The requirements given below are to be read in conjunction with detailed Technical specification & data sheets-A&B (applicable for PLC, LCP and motorized valve actuator), enclosed elsewhere in the specification. Further in case of any discrepancy in the requirement within the specification noted by the bidder, the same shall be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
2. PLC shall be connected to DCS through serial link with MODBUS connection on TCP/IP Protocol compliant for monitoring.
3. PLC shall have the facility to synchronize its time with GPS. Necessary hardware/software for same at PLC end to be provided by bidder.
4. Dual redundant fiber optic cable (single/multi mode) from PLC to DCS shall be in bidders' scope.
5. All instrumentation/signal cables shall be provided by BHEL as free issue whereas cable schedule, cable interconnections and wiring diagram for the same shall be in bidders' scope.
6. Each PLC shall be provided with LIU (Light interface unit and patch chord) which has single / multi mode SC couplers / adapters at PLC end. Same shall be in bidders' scope.
7. Mounting of all interfacing hardware (information outlets, LIU/Patch Panel) and connectivity from PLC to LIU/patch panel (cabling, all interfacing etc) at PLC end, shall be in bidders' scope.
8. The bidder to furnish the list of instruments and list of drives / loads along with their bid.
9. Control valves shall have pneumatic actuators.
10. The UPS output power supply shall be 230V AC with 60 min. battery backup. For further detail, please refer to UPS scheme, given under title "Technical specifications, data sheet and quality plan for PLC & PLC configuration diagram"
11. PLC based local panels shall have redundant processors, power supply and communication. The I/O card redundancy is required only for critical control loops. PLC's shall be hooked to DCS via data link monitoring and hardware (as per spec.). It shall have CRT, keyboard (preferably Laptop) for operator interface.
12. PG/DPG/PS/PT shall have chemical/diaphragm seal as per requirement.

(106)

Control Philosophy for Auxiliary Packages


CONTROL SYSTEM FOR AUXILIARY PACKAGES
400 MW MARIB PHASE-II GTPP, YEMEN

| Sl.N o. | System / Package | Control System | Control from | | Interface with DCS (for monitoring only) | Interface |
|------------|--|---|------------------|-----|--|--|
| | | | Local Control | CCR | | |
| 1. | Air Conditioning System | Relay based Control cum Annunciation panel with solid state annunciation windows along with product integrated microprocessor panel for the Chilling unit. | YES | NO | None | |
| 2. | Ventilation System | Local control | YES | NO | None | |
| 3. | Fire Detection & Protection System+ Fire Water Pumps | Microprocessor based detection, PLC based pump controls and solid state annunciation | YES | NO | CRITICAL HW & SOFT | PLC with OEWS. Separate OEWS for microprocessor based Fire Detection and Alarm System. |
| 4. | Compressed Air System | Microprocessor for individual compressors. | YES | NO | CRITICAL HW & SOFT | All drive logics in microprocessor based LCP which is part of individual compressor skid. |
| 5. | Sewage Treatment + ETP | PLC based | YES | NO | CRITICAL HW & SOFT | |
| 6. | Pre-Treatment Plant + RO DM PLANT | PLC based | YES | NO | CRITICAL HW & SOFT | |
| 7. | Misc. pumps(WATER SYS) | DCS | | | N.A. | |

NOTES:-

- (1) OEWS indicates Operating & Engineering Work Station (in vendor scope)
- (2) PLC system without OEWS shall have panel mounted pushbuttons, lamps, HW annunciation and MIMIC etc. (in vendor scope)
- (3) All PLC shall be with Hot Redundant Processor.

**Technical specifications, Quality plan and
Data sheet for PLC**

| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 1 | OF 9 |

1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to Mumbai port CHA Godown of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipments and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

- 2.1. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function).
- 2.2. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The system shall have self-diagnostic features. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B.
- 2.3. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware / software interface for two-way transfer of signals.
- 2.4. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Data sheets).
- 2.5. In case OWS is provided, HMI functions like Trends, Curves, Bar charts, Historical storage of Data, Logs and reports etc. shall be provided in addition to Plant-schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.6. It shall be possible to use the same OWS as programming station.
- 2.7. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.8. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.
- 2.9. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.

3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

3.1. CODES AND STANDARDS

3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.



TITLE:

SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM

SPECIFICATION NO. PES-145-36

VOLUME **II-B**SECTION **D**

REV. NO. 02

DATE: June 25, 2012

SHEET 2 OF 9

3.1.2. PLC shall conform to IEC: 1131

3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 2.0 mm for load bearing sections (mounted with instruments) and Not less than 1.6 mm for others

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicold, with engraved lettering.


3.2.4. 25 x 6 mm Copper ground bus to be provided for each panel.

3.2.5. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.

3.2.6. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B.

3.2.7. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

(111)

| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 3 | OF 9 |


3.3. PROCESSORS

- 3.3.1. The microprocessors shall be 32 bit, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable.

3.4. INPUT / OUTPUT Modules

- 3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.
- Analog Input Module: 16
 - Analog Output Module: 16
 - Binary Input Module: 32
 - Binary Output Module: 32
 - Analog Input/output combined: 16
 - Binary Input/output combined: 32
- 3.4.2. On line I/O replacement: All I/O cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.
- 3.4.3. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.

112

| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 4 | OF 9 |

3.4.4. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per "Data sheet A & B for PLC System". In case coupling relays are located in PLC Panel, the same shall be in PLC vendor's scope of supply.

3.4.5. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.


3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

113

| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 5 | OF 9 |

3.8. COMMUNICATION WITH PLANT DCS

- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS.
- 3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.
- 3.8.3. Serial communication to DCS shall be MODBUS connection on Ethernet based TCP/IP Protocol.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.
- 3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories at PLC end for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of Fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.

3.9. POWER SUPPLY Scheme


- 3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, as per the scheme PE-SD-999-145-001, sh-08 of 08. Each UPS shall have 60 minutes back up. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc
- 3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable form UPS of PLC panels.
- 3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from either one of the UPS

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/Output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings
- Power distribution scheme.

114

| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 6 | OF 9 |

- Block logic diagrams.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares
- Quality plan
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

4.2. For Information:

- Cable schedule and cable interconnection drawing(in BHEL approved format)
 - Between Field and PLC
 - Between Field and MCC
 - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.


5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
 - Surge protection test as per IEC-225-4
 - Dry heat test as per IEC-68-2-2
 - Damp Heat test as per IEC-68-2-3

115

| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 7 | OF 9 |

- Vibration Heat test as per IEC-68-2-6
- Electrostatic discharge test as per IEC-801-2 or equivalent
- Radio frequency Immunity test as per IEC-801-6 or equivalent
- Electromagnetic Immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

7.1. Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

~~7.2. Mandatory Spares~~

NOT APPLICABLE

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

7.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 10 years after guarantee period.

8. MARKING AND PACKING

8.1. Marking:


A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:

Sea worthy packing 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.

9. PERFORMANCE AND GUARANTEE

16

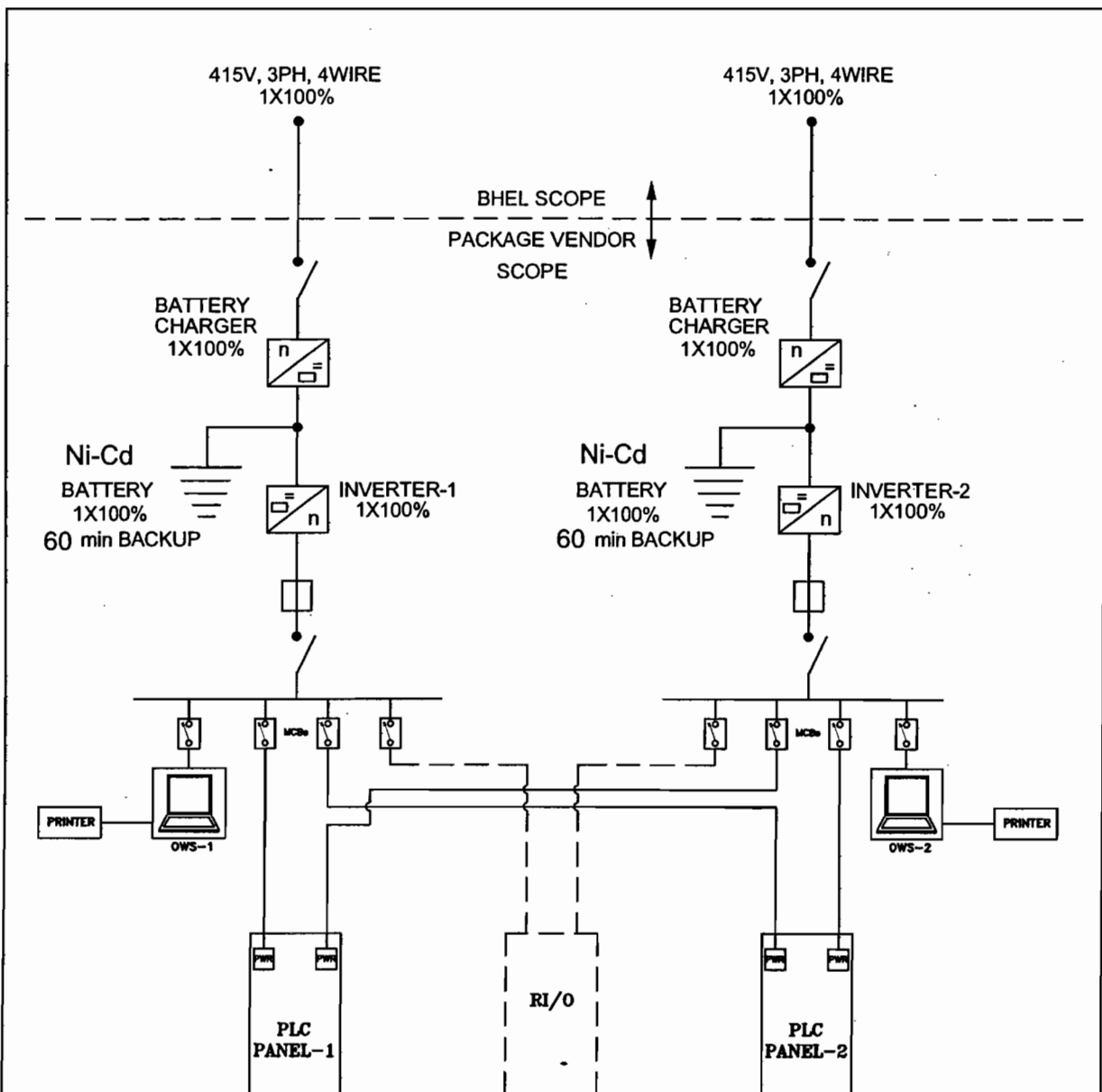
| | | | |
|---|--|------------------------------|---------------------|
|  | TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM | SPECIFICATION NO. PES-145-36 | |
| | | VOLUME II-B | |
| | | SECTION D | |
| | | REV. NO. 02 | DATE: June 25, 2012 |
| | | SHEET 8 | OF 9 |

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-II B Section - B or Section - C.

10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PES-145-36-DS1-0
- Data Sheet C for PLC system - PES-145-36-DS2-0



NOTE: This configuration is typical for two PLCs and one RI/O. Consider only PLC Panel-1 configuration in case RI/O is not applicable.

UPS SCHEME

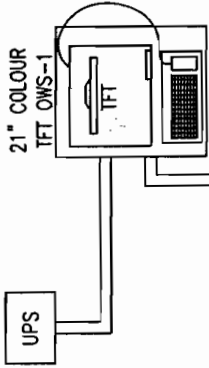
TYPICAL POWER SUPPLY ARRANGEMENT FOR PLC BASED CONTROL SYSTEM

| | | | | | | |
|--|---|----------------------------|------|-----|--------|----------|
| | BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NEW DELHI | DEPT | NAME | | SIGN | DATE |
| | | CODE | DRN | GA | | 26.08.07 |
| | | I | DSGN | SSB | | 26.08.07 |
| | | | CHD | AK | | 26.08.07 |
| | | | APPD | AK | | 26.08.07 |
| | | DRG. NO. PE-SD-999-145-001 | | | | |
| | | SHEET 09 OF 09 | | | REV 00 | |

SYSTEM CONFIGURATION DRAWING

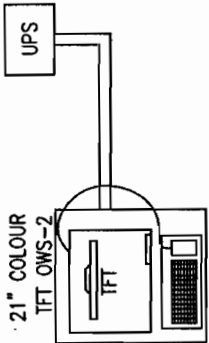
CRT-1

ENGINEERING/OPERATING
STATION



CRT-2

OPERATING STATION

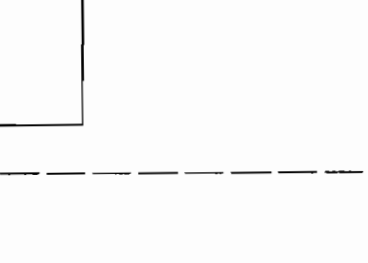
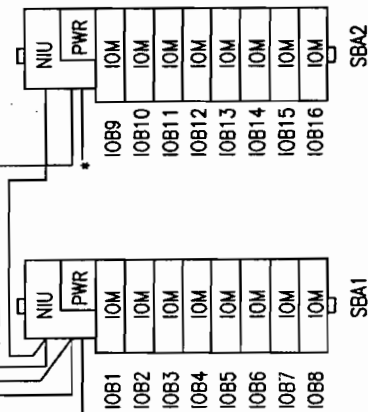
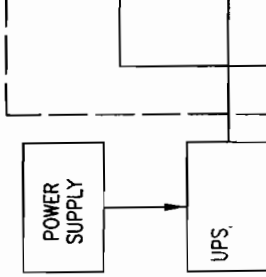
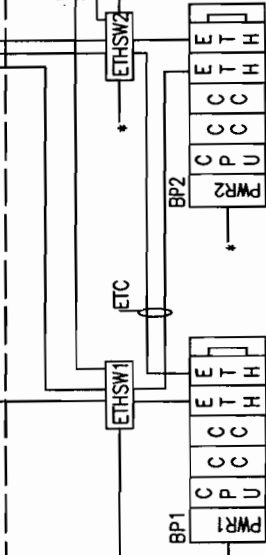
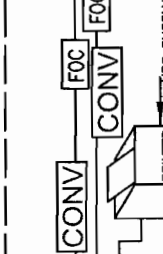


NOTES:

- 1) All fiber optic patch chord shall be terminated to LIU.
- 2) PLC shall have the provision to accept time synchronization signal from GPS and vendor to inform the type of signal required.
- 3) PLC shall have dual redundant link with main DDCMIS. The necessary hardware/software at PLC end shall be in vendor's scope.
- 4) CONV indicates combination of LIU and Patch Chord (LIU + PATCH CHORD)

* Power supply from UPS.

FIBER OPTIC LINK
TO DDCMIS



119

PROJECT: 4X100MW GTPS
MARIB-II, YEMEN

TITLE: SYSTEM CONFIGURATION
GEN

**DATA SHEET FOR PLC SYSTEM**

SPECIFICATION NO.:

VOLUME II B

SECTION D

REV. NO. 02

DATE: 19.07.2008

SHEET

1


OF

1

Data Sheet No.: PES-145-36-DS1-0

Data Sheet A & BDATA SHEET-A FOR PLC SYSTEM
(TO BE FILLED BY PURCHASER)DATA SHEET - B
(TO BE FILLED BY BIDDER)

| | | | |
|--------------------------------------|--|--|--|
| GENERAL | PROJECT | 4X100MW MARIB GTPS-II | |
| | SERVICE | | |
| | QUANTITY | <input type="checkbox"/> UNITISED <input checked="" type="checkbox"/> COMMON | |
| | LOCATION | <input type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR | |
| PLC EQUIPMENT | MAKE / MODEL NO. | BIDDER TO INDICATE | |
| | PROCESSOR | REDUNDANT WITH HOT STANDBY | |
| | DATA BUS (HMI) | <input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC | |
| | DATA BUS (I/O - CPU) | <input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC | |
| | DATA BUS (REMOTE I/O - CPU) | <input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC | |
| | FIELD CONTACTS INTERROGATION VOLTAGE | <input checked="" type="checkbox"/> 24 V <input type="checkbox"/> 48 V | |
| | LOCATION OF COUPLING RELAYS | <input checked="" type="checkbox"/> MCC <input type="checkbox"/> PLC PANEL | |
| | DESKTOP OWS QUANTITY | <input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO <input type="checkbox"/> _____ | |
| | DESKTOP MONITOR TYPE | <input type="checkbox"/> 19" <input checked="" type="checkbox"/> 21" TFT/CRT MONITOR | |
| | PRINTER (A4) - QUANTITY | INKJET LASER BW COLOR INKJET COLOR LASER <div style="border: 1px solid black; padding: 2px;">A-3 size color laser-1 No.</div> | |
| | PRINTER (A4) - MODEL | INKJET LASER BW COLOR INKJET COLOR LASER _____ _____ _____ _____ | |
| PROGRAMMING / CONFIGURATION FACILITY | A) <input type="checkbox"/> HAND HELD B) <input type="checkbox"/> ENGINEERING SOFTWARE <input checked="" type="checkbox"/> ONE OWS <input type="checkbox"/> ALL OWS <input type="checkbox"/> _____ | | |
| SAFETY STANDARD | _____ | | |
| | COMPUTER FURNITURE | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | |
| PANEL | QUANTITY | BIDDER TO INDICATE | |
| | CLASS OF PROTECTION | <input type="checkbox"/> _____ | |
| | REMOTE I/O PANEL | <input type="checkbox"/> YES <input type="checkbox"/> NO <div style="border: 1px solid black; padding: 2px;">As required</div> | |
| | COLOUR | AS PER IS-5 SHADE _____ | |
| | BACK-UP DESK | <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | |
| | MIMIC | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | |
| | CONTROL HARDWARE | <input type="checkbox"/> PB <input type="checkbox"/> INDICATORS <input type="checkbox"/> FACIAS _____ Nos. <input checked="" type="checkbox"/> OTHERS <div style="border: 1px solid black; padding: 2px;">OWS & EWS</div> | |
| COMMUNICATION TO OTHER SYSTEM | HARDWIRED | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <div style="border: 1px solid black; padding: 2px;">Critical only & rest through soft link</div> | |
| | PURPOSE | <input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING | |
| | MEDIUM | <input type="checkbox"/> UTP <input checked="" type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS | |
| | TIME SYNCHRONIZATION SIGNAL FORMAT | <input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IIRIG-B | |
| | SOFTLINK | <input checked="" type="checkbox"/> MODBUS <input type="checkbox"/> OPC | |
| | SERIAL LINK | COMMUNICATION PORT TYPE _____ | |
| POWER SUPPLY INPUT FEEDER | PLC PANEL | BIDDER TO INDICATE LOAD DATA | |
| | REMOTE I/O PANEL | BIDDER TO INDICATE LOAD DATA | |

| | | | | |
|---|--------------------------------------|--------------------|--------------------|------------------|
|  | DATA SHEET FOR PLC SYSTEM | | SPECIFICATION NO.: | |
| | | | VOLUME II B | |
| | | | SECTION D | |
| | | | REV. NO. 02 | DATE: 19.07.2008 |
| | | | SHEET 1 | OF 1 |
| Data Sheet No.: PES-145-36-DS2-0 | | | | |
| Data Sheet C | | | | |
| DATA SHEET - C (TO BE FILLED BY BIDDER AFTER AWARD OF CONTRACT) | | | | |
| GENERAL* | PROJECT | | | |
| | SERVICE | | | |
| | QUANTITY | | | |
| | LOCATION | | | |
| PLC EQUIPMENT | MAKE / MODEL NO. | | | |
| | PROCESSOR | | | |
| | DATA BUS (HMI) | | | |
| | DATA BUS (I/O - CPU) | | | |
| | DATA BUS (REMOTE I/O - CPU) | | | |
| | FIELD CONTACTS INTERROGATION VOLTAGE | | | |
| | LOCATION OF COUPLING RELAYS | | | |
| | DESKTOP OWS QUANTITY | | | |
| | DESKTOP MONITOR TYPE | | | |
| | PRINTER (A4) - QUANTITY | | | |
| | PRINTER (A4) - MODEL | | | |
| | PROGRAMMING / CONFIGURATION FACILITY | | | |
| | SAFETY STANDARD | | | |
| | | COMPUTER FURNITURE | | |
| PANEL | QUANTITY | | | |
| | CLASS OF PROTECTION | | | |
| | REMOTE I/O PANEL | | | |
| | COLOUR | | | |
| | BACK-UP DESK | | | |
| | MIMIC | | | |
| | CONTROL HARDWARE | | | |
| COMMUNICATION TO OTHER SYSTEM | HARDWIRED | | | |
| | PURPOSE | | | |
| | MEDIUM | | | |
| | TIME SYNCHRONIZATION SIGNAL FORMAT | | | |
| | SOFTLINK | | | |
| | SERIAL LINK | | | |
| POWER SUPPLY INPUT FEEDER | PLC PANEL | | | |
| | REMOTE I/O PANEL | | | |

105

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

| | | | |
|--------------------------------------|---|------------------|---|
| QUALITY PLAN NO.: PE-QP-999-145-I036 | | | |
| VOLUME IIB | | | |
| SECTION D | | | |
| REV. NO. 01 | | DATE: 24.08.2007 | |
| SHEET | 5 | OF | 8 |

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT..

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

| | | | |
|--------------------------------------|---|------------------|---|
| QUALITY PLAN NO.: PE-QP-999-145-1036 | | | |
| VOLUME IIB | | | |
| SECTION D | | | |
| REV. NO. 00 | | DATE: 23.03.2005 | |
| SHEET | 6 | OF | 8 |

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

| | | | |
|--------------------------------------|---|------------------|---|
| QUALITY PLAN NO.: PE-QP-999-145-1036 | | | |
| VOLUME IIB | | | |
| SECTION D | | | |
| REV. NO. 00 | | DATE: 23.03.2005 | |
| SHEET | 7 | OF | 8 |

6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:-- Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.


**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

| | | | |
|--------------------------------------|---|-------|---|
| QUALITY PLAN NO.: PE-QP-999-145-1036 | | | |
| VOLUME IIB | | | |
| SECTION D | | | |
| REV. NO. 00 | | DATE: | |
| 23.03.2005 | | | |
| SHEET | 8 | OF | 8 |

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

125

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-4036 | | | |
|---|--|---|------------|----------------------|-----------------|---|--|---------------------------------|-----------|----------|---|--------------------------------------|--|------------------|--|
| | | VOLUME | | IIB | | SECTION | | D | | REV. NO. | | 01 | | DATE: 24.08.2007 | |
| | | SHEET | | 1 | | OF | | 8 | | | | | | | |
| 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 | | | | |
| 1.0 | Materials /Components | | | | | | | | | | | | | | |
| 1.1 | Panels & Control Desks | Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps | MA | Visual | 100% | Contract specifications, Approved GA Drawings, BOQ | As per ref documents. No physical damage. | BHEL Quality Inspection Report. | 3/2 | 2 | 1 | | | | |
| 1.2 | Power Supply/Packs, Battery & Battery charger, Transformer, UPS. | Physical Inspection Physical Damages Dimensions Mounting Accessories | MA | Visual | 100% | Contract specifications, BOQ. | As per reference documents, Test Report | BHEL Quality Inspection Report. | 3/2 | 2 | 1 | | | | |
| 1.3 | Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers | Physical Verification Physical Damages Dimensions Accessories | MA | Visual | 100% | Contract specifications, BOQ. | As per ref documents No physical damage. Test/ Calibration report. | BHEL Quality Inspection Report | 3/2 | 2 | 1 | | | | |
| 1.4 | PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet | Physical Inspection <ul style="list-style-type: none"> • Identification Labels • Physical Damages • Quantity • Spare Capacity | MA | Visual | 100% | Product Catalogue, Data sheets, Approved Configuration diagram, BOQ | As per ref documents. Test Certificates | BHEL Quality Inspection Report. | 3/2 | 2 | 1 | | | | |

| | | | | | | | |
|-----------|----|----------------------------|----|---|-------------------------------|---|--------------|
| LEGEND: * | CR | - Critical characteristics | \$ | P | - Agency Performing the Test. | 1 | - BHEL |
| | MA | - Major characteristics | | W | - Agency Witnessing the Test. | 2 | - Vendor |
| | MI | - Minor characteristics | | V | - Agency Verifying the Test. | 3 | - Sub-vendor |


103

126

| STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1036 | | | |
|---|---|--|------------|----------------------|-----------------|---|-----------------------------|---------------------------------|-----------|--------------------------------------|---|---------|--|
| | | | | | | | | | | VOLUME IIB | | | |
| | | | | | | | | | | SECTION D | | | |
| | | | | | | | | | | REV. NO. 01 | | | |
| | | | | | | | | | | DATE: 24.08.2007 | | | |
| SHEET 2 OF 8 | | | | | | | | | | | | | |
| 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 | | |
| 1.5 | CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD. | Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers | MA | Visual | 100% | Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ. | As per reference documents. | BHEL Quality Inspection Report. | 3/2 | 2 | 1 | | |

127

| | | | | |
|---|--|----|--|--|
| 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 PROGRAMMABLE LOGIC CONTROLLER | | QUALITY PLAN NO.: PE-QP-999-145-I036 | | | | | | | | | | |
|---|-----------------------|--------------------------------------|------------|----------------------|-----------------|---------------------|------------------|-------------------|-----------|---|---|---------|
| | | VOLUME IIB | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | |
| | | REV. NO. 01 DATE: 24.08.2007 | | | | | | | | | | |
| | | SHEET 3 OF 8 | | | | | | | | | | |
| 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 | |

| | | | | | | | | | | | | |
|-----|---|--|----|--------------------|------|---|--|---------------------------------|---|---|---|--|
| 2.0 | Assembly | | | | | | | | | | | |
| 2.1 | Functional Test for HMI/OWS devices such as Monitors, keyboards, Mouse, Printers etc. | Operation | MA | Functional | 100% | Approved Configuration Diagram & BOQ and FAT | Correct Operation of interconnected Devices of HMI system. | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 2.2 | Hardware Functional Verification. | Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test | MA | Visual/Electrical | 100% | Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard | Test Certification | BHEL Quality Inspection Report. | 2 | 2 | 1 | |
| 2.3 | Powering Up | Healthiness of all the modules/equipment, associated with Powering of PLC system | MA | Visual /Electrical | 100% | Approved power supply scheme | All equipment to be healthy on power ON | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 2.4 | Burn in test for PLC modules | Healthiness of PLC modules on Continuous Energisation, Temperature maintenance | MA | Visual/Electrical | 100% | FAT Procedure | Test certification as per FAT | BHEL Quality Inspection Report. | 2 | 2 | 1 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

| | | |
|--|--|--|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | \$ P W V - Agency Performing the Test. - Agency Witnessing the Test. - Agency Verifying the Test. | 1 - BHEL 2 - Vendor 3 - Sub-vendor |
|--|--|--|

28

102

| | | | | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--------------------------------------|--|------------------|--|
|  PEM :: C&I | STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1036 | | | |
| | | | | | | | | | | | VOLUME IIB | | | |
| | | | | | | | | | | | SECTION D | | | |
| | | | | | | | | | | | REV. NO. 01 | | DATE: 24.08.2007 | |
| | | | | | | | | | | | SHEET 4 | | OF 8 | |

| 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 | |

| | | | | | | | | | | | | |
|-----|--------------------------------------|---|----|-------------------|------|---------------|------------|---------------------------------|---|---|---|--|
| 3.0 | Factory Acceptance Test (FAT) | | | | | | | | | | | |
| 3.1 | Input Output Functional Verification | I/O configuration, I/O operation | MA | Visual/Electrical | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 3.2 | Processor Verification | Processor configuration, Powering up, standby operation (as applicable) and Loading | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 3.3 | Power Supply Module Verification | Redundancy Operation | MA | Electrical | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 3.4 | Communication System Verification | Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system | MA | Electrical | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 3.5 | Diagnostic Verification | Self Diagnostic features of PLC system | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 3.6 | Control Panel/Desktop Verification | Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 | 1 | 1 | |
| 3.7 | Software Verification | (i) Control Logics (ii) Engineering Features (iii) HMI Features | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality 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 |
|---|---|--|

**Technical Specifications and Quality plans
for Instruments**

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

General Instrumentation Design Requirements

• Field Instruments

- a. Analog outputs signals from field instrumentation to the control systems are 4-20 mA dc signals. Instrumentation can be self-powered, or loop powered from the control systems. Self-powered analog signals shall be true "isolated from ground" signals.
- b. Switch contacts for control system inputs shall be snap acting type, potential free with a maximum contact rating of 230V AC, 5A.
- c. Transmitters will be used to provide the required 4 to 20mA signals for all controllers and receivers. Transmitters will be of the electronic, two-wire type, capable of driving an output impedance of 600 ohms minimum at 24 V dc, and will be generally powered from the control system I/O cards.
- d. SMART transmitters' calibration shall be carried out through a PC based System to be located in the computer room.
- e. Pressure, flow, differential pressure, level, temperature, and other miscellaneous transmitter accuracy shall be within 0.1% of calibrated span and shall have repeatability of +0.1% of span or better. Errors caused by change in ambient temperature shall not exceed 0.01% of span per °C change. Temperature variations of +55°C shall not affect the 0.1% accuracy rating nor the 0.1% repeatability.
- f. The plant instrument air supply pressure shall be:
1. Maximum supply pressure 7 kg/cm² (To be confirmed by PEC)
 2. Minimum supply pressure 4.5 kg/cm²
- g. All instruments and analysers shall employ RF protection in the system design.
- h. Instrument tags should be permanently attached to the device. If this is not possible, the instrument tag should be fastened to the instrument with stainless steel wire. The wired instrument tag should be supplied as ¾ inch by 3 inch, stainless steel instrument tags. Tag thickness is 1/16 of an Inch and stamped with instrument tag number. Tag number characters are 3/8 inch in height.

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- i. Speed switches and the actual device should drive transducers, if possible.
- j. All instrumentation mounted inside, away from direct exposure to the elements, shall be as a minimum NEMA 4 construction unless it is in an environmentally controlled environment (e.g the control room). If the instrument is mounted in an environmentally controlled environment the instrument shall be as a minimum NEMA 1 construction.
- k. All instrumentation mounted outside, exposed to the elements, shall be as a minimum NEMA 4X construction, unless it is enclosed in a heated instrument enclosure. If the instrument is mounted in a heated instrument enclosure the instrument shall be as a minimum NEMA 4 construction.
- l. Transmitters and switches shall be grouped and mounted in open racks depending on the location. Individual instruments shall be mounted on stanchion or pipe mounted.

All field instruments junctions boxes & local panels located in hazardous area shall be explosion proof as per the area classification drawing.

- m. The following metric engineering units shall be used for all instrumentation devices :

1. Pressure – bar (g)
2. Temperature - °C
3. Steam flow – kg/hr
4. Liquid flow – m³/hr
5. Distance – meters (m) or millimeters (mm)
6. Differential pressure – mmH₂O

- **Control Valves**

- a. Control Valves are defined as Pneumatic operated modulating valves.
- b. Instrument air shutoff valve shall be provided on each control valve assembly.
- c. The following end connections shall be used when weld type connections are specified in the piping line specification:
 1. Socket weld end connections: 2 inch and under control valve bodies.
 2. Butt weld end connection : 2-1/2 inch and over control valve bodies.
- d. Valve bodies shall be Globe, single – port unless otherwise required and shall be not more than two nominal sizes smaller than the line in which they are installed.
- e. Valve body material shall be as specified in the piping line specifications.

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- f. All integrally mounted instrumentation (control rollers, positioners, regulators, etc.) to be designed for a maximum instrument air supply pressure of 7kg/cm^2 . Minimum instrument air supply pressure is 4.5kg/cm^2 . Separate air filter regulators with inlet and outlet gauges shall be provided for each control valve.
 - g. Electro-pneumatic positioners shall be integrally mounted to the control valves. The I/P transducer shall be integral to the positioner.
 - h. Pneumatic controllers for control valves will be limited to control loops that do not require any interface with any receiver installed in the main control room. Pneumatic temperature controllers will have filled bulb type sensing elements. Pneumatic pressure controllers will have Bourdon tube sensing elements.
 - i. It is the intent that the valves shall fail either open or closed or fail lock in the event of failure of air signal or electric signal from any valve component (controller or positioner), as well as failure of the main control air supply or voltage to the solenoid.
 - j. Position transmitters of non-contact, 2-wire 4-20mA DC type shall be provided for modulating control valves. Also in general limit switches shall be provided for control valves.
 - k. Pilot solenoid valves for on-off service control valves are to be designed for 24 Vdc with a minimum orifice size of $\frac{1}{4}$ inch.
 - l. Instrument tubing is to be stainless steel, in accordance with the tubing line specifications. Minimum tubing size is $\frac{1}{4}$ inch, SS-316.
 - m. Control valve limit switches to be designed to operate at 24 VDC.
 - n. The control valves shall generally have the max. flow handling capacity of 120% and the limit of valve travel shall generally be between 10% and 80%.
 - o. The following shall be specified for control valves.

Max. noise – 85 dBA from 1m. distance.
 - p. The max. permissible outlet velocity shall be as per ISA-S75.01 based on service (liquid, steam or flashing services).
 - q. Whenever fire safe requirement is specified for a Emergency shutdown valve, the valve body as well as the actuator shall meet the testing requirements API 617 latest revision. In addition to above, air volume tank shall also be provided for a storage of air volume with minimum two full strokes of valves. All valve accessories like solenoid valve, limit switches and. volume tank etc shall also be enclosed in a certified fireproof enclosure. The cable used for the actuation of the valve shall also be fire resistant (Fire survival to IEC 331). For shutdown valves leakage class VI shall be considered. No by-pass valve or hand wheel shall be used for shutdown valves.
- **Flow Instrumentation**
 - a. Flow Orifice plates will be used for Natural Gas flow to turbine and other critical measurements where weld-in construction is required. Positive displacement flow meters and totaliser will be used for oil flow.
 - b. Orifice plates shall conform to requirements of ASME "Fluid Meters".

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- c. Flow nozzles shall be of the weld-in holding ring type ASME long radius, with dual wall taps and shall be of stainless steel. Flow nozzles shall be furnished complete with metered runs in accordance with ASME PTC 6.1. Metered pipe run and nozzle shall match the pipe material and size that metered section is to be installed in.
- d. Orifice plates shall be 316SS, sharp square edge thin plate, and paddle type suitable for installation between raised face orifice flanges. Orifice flanges, gaskets and jacketing screws shall be furnished by the Supplier. Paddle shall be stamped with the orifice ID bore diameter on the upstream side. Orifice flanges will be of the raised face, weld-neck type with 2 or 3 sets of taps as required for redundancy.
- e. Beta ratios shall be between 0.2 and 0.7. Flow elements (flow nozzle & orifice) sizing shall as per BS-1042/ISO-5167.
- f. Differential type flow transmitters shall be supplied with three valve manifolds directly mounted to the transmitter.
- g. Differential type flow transmitters shall be electronic, analog 2-wire transmitters with isolated 4-20 mA dc output signals.
- h. Square root extraction of the flow signal is performed in the DCS.
- i. Positive displacement type flow meters shall be used for oil flow measurement.

• Pressure Instrumentation

- a. Pressure transmitters are electronic, analog 2-wire transmitters with isolated 4-20mA dc output signals.
- b. Pressure transmitters will be supplied with integral mounted two valve manifolds.
- c. All pressure transmitters shall be capable of withstanding their body rating conditions without permanent damage or loss of calibration.
- d. Differential pressure transmitters of the capacitance type, regardless of the applied service, shall be capable of withstanding a differential pressure equal to full process pressure on either side of the measurement element without damage or loss of calibration.
- e. Differential pressure transmitters will be supplied with integral mounted three valve manifolds.
- f. Pressure gauges will be generally 150mm dial, solid front safety case type with blowout back, 1/2" NPT bottom connection, drawn stainless steel case, 316SS bourdon and socket, stainless steel movement, micrometer pointer. Pulsation dampers will be provided for pulsating pressure services. Liquid filled gauges shall be used for all pump discharges, vibrating or pulsating services.
- g. Pressure switches will generally be snap acting type, DPDT action, with individual "on" and "off" points to be on a calibrated scale or dial.

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- h. Dual type control switches such as pressure switches having two sets of contacts with independently adjustable set points shall not be used where set point adjustment and deadband are a problem (e.g. low pressure and vacuum applications). If a potential problem exists, two single purpose switches shall be used.
- i. The gauges shall have $\pm 1\%$ accuracy and over range protection of 125%.
- j. The switches shall have the following :

| | | |
|---------------------|---|-----------------|
| Max. Contact rating | : | 230V AC, 5A |
| Repeatability | : | $\pm 0.5\%$ FSR |

• Temperature Instrumentation

- a. For temperature up to 300°C 3-wire RTD duplex type, PT 100 type shall be used. For temperature beyond 300°C thermocouples shall be used. Thermocouples shall be manufactured in accordance with the ISA Standard MC96.1, Temperature Measurement Thermocouples. All thermocouples shall be Chromel Alumel (Type K) for $300^{\circ}\text{C} \leq T < 850^{\circ}\text{C}$. R or S type for $T > 850^{\circ}\text{C}$.
- b. The mV signal of thermocouple shall be used as input to the DCS. Cold junction compensation shall be achieved in the DCS
- c. Thermocouples shall have duplex elements and grounded measuring junction.

All thermowell in a high velocity line or duct shall have an ASME PTC 19.3 calculation for determination of the wells resonant frequency. Thermowells that do not meet the acceptance criteria shall be resized or relocated as necessary.
- d. An extension nipple / union / nipple of sufficient length to extend beyond lagging and connection head shall be furnished for each thermocouple assembly. Terminal blocks shall be marked with polarity and connectors shall be resistant to heat, vibration and galling. The cap shall provide a weather tight enclosure and a chain shall be provided to prevent loss of cap. The cap shall be made of cast aluminium.
- e. RTDs of Duplex type furnished by the Supplier shall be of the three-wire type made with 100 ohm platinum resistance elements. They shall be certified to meet the requirements of the International Temperature Scale, calibrated to the IEC-751 standard ($\alpha = 0.00385 \text{ Ohms/Ohm/}^{\circ}\text{C}$), and be guaranteed to an accuracy to within $+1.1^{\circ}\text{C}$ of this standard. The RTDs shall be contained in an insulated material and a sheath or sleeve of stainless steel SS-316 and shall be so mounted that they can withstand the greatest shocks and vibrations that can be imposed upon them in the system piping without deterioration. Specific information shall be furnished concerning type and accuracy of bridge circuits to be used with the RTDs. RTDs shall be directly connected to DCS without any transmitters.
- f. Unless specified otherwise, each temperature element and thermometer shall be provided with a 1" socket weld type, 316 stainless steel tapered thermowell suitable for the requirements of the given application.
- g. Thermowell immersion length will generally be between 1/3 and 1/2 the distance to the center of the pipe. Where thermowells are installed in lines smaller than 4 inches,

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

the piping shall be expanded to 4 inch size to accommodate the thermowell. Thermowell shall be drilled from solid bar stock.

- h. All thermowell in a high velocity line or duct shall have an ASME PTC 19.3 calculation for determination of the wells resonant frequency. Thermowells that do not meet the acceptance criteria shall be resized or relocated as necessary.
- i. Thermocouple extension wire is to be solid, shielded, twisted pairs.
- j. If intermediate terminal blocks are required in a thermocouple measuring circuit, they need not be the same material as the thermocouple.
- k. Dial thermometers shall be bimetallic, minimum 150mm dial, every angle form, hermetically sealed with external recalibration adjustment, 1/4" OD SS stem, 1/2" NPT connection and SS case.
- l. Temperature switches shall be actuated by filled bulb-type elements equipped with standard-length armored capillary tubing.
- m. Temperature gauges shall have $\pm 1\%$ accuracy and average protection of 125%.
- n. Switches shall have the following:

| | | |
|---------------------|---|-------------|
| Max. contact rating | : | 230V AC, 5A |
| Repeatability | : | ±0.5% FSR |
| Contact type | : | snap acting |

- **Level Instrumentation**

- a. Differential pressure transmitters will be used for general service level measurement of all tanks and other pressurized vessels.
- b. Differential pressure type level transmitters are electronic, analog 2-wire transmitters with isolated 4-20 mA dc output signals. Displacer and ultrasonic level transmitters will be 24V DC powered, with isolated 4-20 mA dc output signals powered from the transmitters. Displacer type level transmitters are of torque tube type. Displacer type level transmitters shall be used for lub oil tanks.
- c. Constant head chambers shall be furnished for all differential pressure-type level transmitters used with pressurized vessels. Reservoir piping connections shall be 1/2 inch outlet and a 1/2 inch inlet socket-welded type suitable for the pressure and temperature encountered.
- d. Transparent gauge glasses will be used for low-pressure applications. Transparent or reflex gauges will be used for high-pressure applications. All gauge glasses will be equipped with gauge valves, including a safety ball check. Colorless liquid shall be provided with reflex type level gauges.
- e. Level switches shall generally be cage float type, rated for ANSI B31.1 requirements.
- f. DP Level transmitters : Accuracy $\pm 0.1\%$
Level switch : Contact type – snap acting
Contact rating – 230 V AC, 5A,
Repeatability - $\pm 0.5\%$ FSR

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- **Stack Emission Monitoring System**

The use of individual or multiple prefabricated analyser installations shall be used to reduce site installation work. This prefabrication shall include sample conditioners, analysers, air and electrical distribution, cooling water distribution or coolant circulating system all piped and wired on a common frame. Interconnecting pipe work and accessories shall be of stainless steel. The arrangement shall permit testing of the entire assembly before dispatch to site and shall be arranged for convenient removal from on-line operation to facilitate routine maintenance and calibration.

- **Analysis of flue gas / Stack Analysers**

Appropriate analysers of proven type shall perform the analysis of SOX, NOX, CO, etc. in the flue gas.

The equipment shall be constructed for operation in dusty and humid environments at high ambient and flue gas temperatures. The use of equipment capable of multi-parameter measurement shall be considered.

Analysers provided shall have auto-calibration for zero and span as well as self-diagnostic functions.

If sampling of flue gas is used, sampling probes shall preferably be vertically installed on the top of horizontal flue gas ducts, in order to avoid blockages.

In order to keep the sampling lays to acceptable limits the analysers shall be located close to their sample take-off point, so that easy access to the sample take-off point and to the analysers shall be provided for maintenance.

The flue gas sampling lines shall be heated to prevent condensation and shall not form a siphon in the case where condensate may be collected during heater failure. Condensate drainage facilities shall be provided at the analysers.

Generally, the analysers and the sampling probe equipment shall be suitable for mounting in ambient plant conditions, e.g. within a standard cubicle. However, if not feasible, the equipment shall be mounted in an air-conditioned room or container.

Power failure and system failures of analysers shall be monitored in the central control room by a group alarm.

All the stack analyzers output signals shall be repeated in DCS for alarm & monitoring.

- **Vibration Monitoring System**

Online vibration monitoring system shall be provided with vibration transducers, low noise flexible cables in flexible conduits, terminated in JB's, all interconnecting cables, racks/cabinets, power supplies, calibration equipment, indicators, integrating units, signal conditioning devices and all accessories required for completeness of work.

This shall be also placed in local control center and the signals shall be hard wired /serial connected to turbine control panel for interlock and monitoring purpose.

These vibration parameters shall also be communicated to DCS for control and monitoring purpose.

- **Instrument Cables Design Criteria:**

FORMT9-P REV-B

137

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

All cables shall be FRLS outer sheath, armoured, 7 standard copper conductor, cable (for power cable -solid conductor).

| | | |
|--------------------|---|--|
| Signal cable | : | Blue colour outer sheath, screened 1.0 Sq.mm for single pair 0.75 Sq.mm for 8/12 pair, individual pair and overall shielded |
| RTD cable | : | Black colour outer sheath, screened 1.0 Sq.mm for single triad 0.75 Sq.mm for 8 triad, individual triad & overall shielded |
| Control cable | : | Black colour outer sheath, screened 1.0 Sq.mm for 2 cores 0.75 Sq.mm for 8/12/24/48 cores |
| Power cable | : | Black colour outer sheath 2.5 Sq.mm For 2/ 3 cores. |
| Compensating cable | : | Type – KX, yellow colour outer sheath, screened individual and overall, 16 AWG 1/8/12 pair |

9.5.0 Documentation

The following documents shall be furnished along with the bid:

- Detailed description of Turbine control panel and DCS offered
- Reference list for the system application in power plants
- Description of closed loop control with block diagram of hardware configuration
- Description of open loop control with block diagram of hardware configuration
- Description of standard software modules for open loop and closed loop control
- Description of data bus system and bus control
- Description of redundancy and back-up/System availability
- Description of Plant Shutdown Procedure
- Description of control room equipment, control desks, VDUs, keyboards etc., remaining conventional instrumentation (important indicators, alarms etc.)
- Description of VDU displays
- Description of power supply
- Detailed listing of all options available within the system and which of these options are included in the offered scope.
- Description of programming aids (configuration) and fault finding (system diagnosis)

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- List with the detailed scope of equipment offered
- List of spare parts
- Requested modifications of the contract specification text.
- DCS, Turbine control system configuration drawings
- Tentative layout of the CCR
- Filled up technical data sheets (Refer clause 9.9.0 of this volume).

The following documents shall be furnished after award of Contract:

- Layout of CCR with operator consoles and panels
- Layout of CER showing distribution of cabinets and racks
- Detailed layout of auxiliary consoles and panels
- Instrument list
- I/O list (DCS)
- Logic diagrams, interlocking diagrams
- Block diagrams and description of main closed-loop control
- Display sheets (Hard copy)
- Technical specifications of all the field Instruments, DCS, PLC, cables, all erection hardware, panels, analysers, etc including the datasheets
- Manufacturers data sheets of all instruments / modules
- List of Alarms & Trips
- Schedule of SER inputs
- Installation drawings
- Instrument Loop diagrams
- Wiring diagrams / Interconnection schedule
- Terminal diagrams
- Cable Schedule (Signals / control / power)
- Users manuals and other reference manuals
- DCS loading details
- Data base configuration
- Factory acceptance test procedure

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

- Test certificates
- Certificates from statutory bodies
- Logs and report formats
- Instrument Location Layout drawings (area/elevation wise)
- Junction box schedule
- All other lists and drawings as required
- DCS vendor drawings/documents
- All the above drawings as applicable for the mechanical packages

The Contractor shall ensure that the final draft of all schedules, lists or data sheets for C&I equipment are produced to a uniform format irrespective of whether the source of the above schedules, lists and data sheets is in the main Contractor or a Sub-contractor of the main Contractor. All documents shall carry a uniform numbering system.

9.6.0 Spares

The below spares philosophy is to be read in conjunction with the C&I spares given in this document. Special tools and equipment for the maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman.

The special tools and equipment for maintenance and repair shall be delivered by the contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

10% spare instrument for each type and each range, with a minimum of one, for instruments like field transmitters, field switches, pressure and temperature gauges, solenoid valves etc. shall be provided.

For control valves, float level switches, displacer type level transmitters, level gauges etc. only critical parts shall be provided as spare.

20% or minimum 1 No. of each type of module shall be provided for DCS and Turbine control panel systems.

This spare philosophy shall be applicable for main systems as well as auxiliary systems.

Apart from the above spares, the Contractor shall furnish the list of spares recommended by him for 2 years of trouble free operation of the plant.

9.7.0 Commissioning

The Contractor shall be responsible for installing, checking / calibrating of all the instruments and systems, laying and connecting of all interconnecting cables right from the field to the respective local control panel or central control / electronics rooms, termination of all cables, laying and connecting data highways, testing the system, loop checking from field to receiver instruments / system and commissioning the instruments and systems.

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

C&I Spares :

The Contractor must indicate and include in his scope of supply the following:

- a) All the necessary start up spares
- b) Recommended spares for two (2) years of normal operation of the plant with unit & total prices.

Furthermore the contractor shall also provide a list of recommended spares for five (5) years operation including major overhaul along with the price schedules.

The Purchaser reserves the right to finalise the exact quantities of the recommended spare parts and effect price adjustment on the basis of the unit rates quoted by the Contractor.

The spares ordered by the Purchaser shall be delivered at the site not later than the date of issue of Taking over Certificate.

Price of the recommended spares will not be taken into consideration for the evaluation of the bids. They shall remain firm up to Twelve (12) months from the date of finalisation of EPC contract for the power plant. Purchase of these spares parts will be covered by a separate order which will be issued only after the receipt of the complete instruction manuals for the equipment from the Contractor. Instruction manuals for major plant / equipment shall be submitted by contractor within Six (6) months from date of finalisation of contract. If the submission of O & M manuals are delayed the validity of offer for recommended spares shall be correspondingly extended. The bidder should confirm that the recommended spares shall be delivered at site within three months of the placement of order.

All spares supplied under this Contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at site e.g small item shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

Each spare shall be clearly marked or labelled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such case and a detailed list should be enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

In the schedule of the recommended spares, the bidder shall clearly state and identify separately the spare parts manufactured by the supplier, the spare which are bought out locally from the indigenous manufacturers and the spares which are imported from other countries. The sources of the supplier of the spares not manufactured by the supplier shall be furnished. The complete details of such spares to enable the Purchaser to place orders directly for his future requirements, shall also be furnished.

All spare parts supplied shall be new and unused.

General Requirements

(1) Tendering procedure of spare parts

The tenderer shall prepare in his tender a complete list of recommended spares required for two (2) years of normal operation. The list shall give for each spare part, the number of equipment installed in the plant, the number of spares supplied, the unit price and the total price as well as the grand total. Also, the tenderer shall provide a list of recommended spares for five (5) years operation along with the price schedules.

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

(2) Criteria for selection of Spare Parts

The Tenderer shall recommend and propose spares for equipment parts in accordance with the following three categories :

Category - I - Spare parts that are subject to:

- (a) Wear, tear, erosion and corrosion during normal operation.
- (b) Failure that would result in shut down of the equipment.
- (c) Failure that would cause troublesome operation of the equipment.

Category - II - Small parts that are subject to:

- (a) Damage or breakage during routine maintenance or inspection such as gaskets, packings, bolts, t, etc. of general use (mechanical parts)
- (b) Same, such as fuses, lamps, etc. of general use (electrical and instrument parts).

In preparing the spare parts list, the Tenderer shall critically examine the equipment Vendor's recommended spare parts list both to ensure completeness and eliminate items which combine low wear and breakage factors based on anticipated operating conditions (continuous, intermittent or occasional, severe or mild) and short delivery time.

Category - III - Recommended spare parts required for major overhaul, combustion path inspections.

Also the possible interchangeability of parts of similar equipment (pumps, motor, instruments, electrical, etc.) shall be given due consideration.

Fast consumable items like indicating lamps, fuses, etc. shall be easily replaceable by local sources.

(3) Start - up Spare Parts:

Start - up spares are those spares, which may be required during the start-up and commissioning of the equipment and/or system. All spares used until the plant is handed over to the Purchaser shall come under this category. The Contractor shall provide for adequate stock of such start-up spares to be brought by him to the site during the plant erection and commissioning. They must be available at site well in time and can be taken back from there only after the receipt of the Taking Over Certificate.

(4) Spare Parts management System :

It is the Purchaser's intention to implement a general spare part management system for phase-I & II plants . The basis for setting up the data base of this spare part management system is the "SPIR" form (Spare Parts list and Interchangeability Record).

The Contractor shall carefully prepare / fill in the SPIR forms for all spare parts supplied under this contract. Particular emphases shall be placed on :

- (a) Indicating the prime manufacture's real part number.

4 X 100MW MARIB GTPS - II

Technical Specifications (C&I) for Auxiliary packages

(b) Attaching all manufacturer's drawings to the SPIR forms

(c) Providing a true interchangeability record.

(d) Giving realistic price information.

SPIR Forms shall be submitted in required copies at least four months before spare parts delivery. They shall be subject to the Purchaser's approval.

It is recommended that the forms are completed by the equipment manufacturer, for example, on the following items :

(a) Equipment registration number of tag number for each piece of equipment as stated in requisitions and/or purchase orders.

(b) Manufacturer's model, type or other positive identification reference of the equipment / instruments, ordered.

(c) Total number of pieces of identical equipment / instrument as quoted.

(d) Purchasing company's order reference number.

(e) List of all parts which should be carried in stock for normal operation and also list of slow-wearing parts. If an item is interchangeable between two or more units it should be listed once only.

(f) Drawing number of spare parts

(g) Reference numbers/letters or other information which identical each part. Interchangeability with identical parts within the manufacturer's range should be indicated.


(h) Material specification in terms of international codes standards and accepted conventions, not manufacturer's or sub-manufacturer's references.

(i) For each unit or group of identical units, the number of parts fitted in each unit of equipment of instrumentation.

(j) The total number of identical parts in all equipment specified.


(k) Approximate ex-works price per piece of each part in the currency shown at the top of the column.

143

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR PRESSURE AND DIFFERENTIAL PRESSURE GAUGES | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1026 VOLUME IIB SECTION D REV. NO. 01 DATE: 16.05.2007 SHEET 1 OF 2 | | | |
|---|------------------------------------|--|------------|----------------------|--------------------------|---|---|-------------------------------------|--------|-----|------|--|--|--|--|
| 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 | | | | |
| 1.0 | Material / Components | | | | | | | | | | | | | | |
| 1.1 | Casing, Bourdon tube, and Movement | 1. Chemical composition | MA | Chemical Test | One Sample from each lot | Approved drg. / data sheet / BHEL Spec. | Relevant raw material std. | Test Certificate | 3/2 | — | 2,1# | # Compliance certificate to be verified. | | | |
| | | 2. Workmanship, finish and dimensions | MA | Visual, Measurement | 100% | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Inspection Report / Log Book | 3/2 | — | 2,1# | | | | |
| 1.2 | Switch | Contact type & number | MA | Visual | 100% | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Test Certificate/ Inspection Report | 3 | — | 2,1# | Applicable for gauge with switch device | | | |
| 2.0 | Assembly | 1. Marking – Tag No., Model, Range | MA | Visual | 100% | - do - | - do - | Inspection Report | 2 | 1 | — | | | | |
| | | 2. Workmanship | MA | Visual | 100% | - do - | - do - | - do - | 2 | 1 | — | | | | |
| | | 3. Dial size, scale graduation | MA | Visual | 100% | - do - | - do - | - do - | 2 | 1 | — | | | | |
| | | 4. End connections | MA | Measurement | 100% | - do - | - do - | - do - | 2 | 1** | 1 | **10% of total quantity with minimum of 2 piece / type & size | | | |
| | | 5. Switch – contact type & nos. | MA | Visual | 100% | - do - | - do - | Inspection Report | 2 | 1 | — | | | | |
| 3.0 | Routine Test | 1. Calibration, accuracy, Hysteresis, overload, set point adjustment / repeatability | CR | Measurement | 100% | - do - | - do - | - do - | 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

AA

|  | | STANDARD QUALITY PLAN FOR PRESSURE AND DIFFERENTIAL PRESSURE GAUGES | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1026 VOLUME IIB SECTION D REV. NO. 01 SHEET 2 OF 2 DATE: 16.05.2007 | | | |
|---|-----------------------|--|------------|----------------------|-----------------|---|---|-------------------|-----------|-----|----|--|--|--|--|
| 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 | | | | |
| | | 2. Hydraulic Test | CR | Measurement | 100% | Approved drg. / data sheet / BHEL Spec. | No Leakage | Inspection Report | 2 | 1** | 1 | | | | |
| | | Ø3. IR, HV | CR | Measurement | 100% | Relevant standard | Relevant standard | - do - | 2 | 1** | 1 | | | | |
| 4.0 | Type Test | 1. Enclosure Protection Class | CR | Verification | Each type | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Test Certificate | 2 | — | 1* | • Type Test Certificate to be verified | | | |
| | | 2. Blow out disc | CR | Verification | Each type | - do - | - do - | - do - | 2 | — | 2* | | | | |
| | | Ø3. Switch contact rating | CR | Verification | Each type | - do - | - do - | - do - | 2 | — | 2* | | | | |
| 5.0 | Painting | Shade & Finish | MA | Visual | 100% | Approved drg. / data sheet / BHEL Spec. / Manufacturer's std. | Approved drg. / data sheet / BHEL Spec. / Manufacturer's std. | Inspection Report | 2 | — | 2 | | | | |
| 6.0 | Packing | Soundness | MA | Visual | 100% | - do - | - do - | - do - | 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 |
|--|---|--|

145

|  STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES | | QUALITY PLAN NO.: PE-QP-999-145-1031 VOLUME IIB SECTION D REV. NO. 01 DATE: 16.05.2007 SHEET 1 OF 3 | | | | | | | | | | |
|---|-------------------------|---|------------|----------------------|------------------------|------------------------------------|------------------------------------|-------------------|----------|----|-----|---|
| 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 | |
| 1.0 | Raw Material/ Component | 1. Chem. Composition | MA | Chemical Analysis | 1 sample from each lot | BHEL Spec. / Approved data sheet | Relevant material standard | Test Report | 3/2 | -- | 2,1 | Relevant compliance certificate to be verified. |
| | | 2. Make, Marking, Damage and Cracks | MA | Visual | 100% | BHEL spec. / manufacturer standard | BHEL spec. / manufacturer standard | Log Book | 2 | -- | -- | |
| | | 3. Leakage (Element Conn.) | MA | Pressure Test | 100% | Manufacturer standard | No Leak | Log Book | 2 | -- | -- | |
| | Micro Switch | 1. No. and type of contacts | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Log Book | 3/2 | -- | 2,1 | |
| | | 2. Continuity | CR | Electrical | 100% | Manufacturer standard | To have continuity | Log Book | 3/2 | -- | 2,1 | |
| 2.0 | Final Inspection | | | | | | | | | | | |
| 2.1 | Assembly | 1. Marking: Range, Model, Tag No, Sl.No. | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | -- | 10% to be witnessed by BHEL |
| | | 2. Correct assembly, workmanship and finish | MA | Visual | 100% | Manufacturer standard | Manufacturer standard | Log Book | 2 | 1 | -- | - do - |

| | | |
|---------|------|-------------------------------|
| 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 |

146

|  STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES | | QUALITY PLAN NO.: PE-QP-999-145-J031 VOLUME IIB SECTION D REV. NO. 01 DATE: 16.05.2007 SHEET 2 OF 3 | | | | | | | | | | |
|---|-----------------------|---|------------|----------------------|-----------------|----------------------------------|----------------------------------|-------------------|-----------|---|---|-----------------------------|
| 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 | |
| 2.2 | Routine Test | 3. Connection | MA | Visual & Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | — | 10% to be witnessed by BHEL |
| | | 4. Scale Marking | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | — | - do - |
| | | 5. Cleanliness | MA | Visual | 100% | Manufacturer standard | Free from scratches dirt etc. | Log Book | 2 | 1 | — | - do - |
| | | 6. Overall Dimension | MA | Measurement | 100% | BHEL Spec. / Approved drg. | BHEL Spec. / Approved drg. | Inspection Report | 2 | 1 | — | - do - |
| | | 1. Overload | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1 | 1 | - do - |
| | | 2. Repeatability | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1 | 1 | - do - |
| | | 3. Set point adjustment | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1 | 1 | - do - |
| | | 4. Differential | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1 | 1 | - do - |

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 PRESS AND DIFF PRESS SWITCHES | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1031 | | | | |
|---|-----------------------|-------------------------------|------------|----------------------|-------------------|----------------------------------|----------------------------------|-------------------|----------|--------------------------------------|---|---|--|--|
| | | | | | | | | | | VOLUME IIB | | | | |
| | | | | | | | | | | SECTION D | | | | |
| | | | | | | | | | | REV. NO. 01 DATE: 16.05.2007 | | | | |
| | | | | | | | | | | SHEET 3 OF 3 | | | | |
| 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 | | | |
| 2.3 | Type Test | 5. Contact Rating | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | — | 1 | Manufacturer compliance certificate to be verified. | | |
| | | 6. Insulation Resistance & HV | CR | Electrical | 100% | Relevant standard | Relevant standard | Test Report | 2 | 1 | 1 | 10% to be witnessed by BHEL | | |
| | | 7. Calibration Test | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1 | 1 | - do - | | |
| | | 8. Accuracy Test | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1 | 1 | - do - | | |
| 3.0 | Packing | 1. Weatherproofness | CR | Measurement | 1 sample / design | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 3/2 | — | 1 | Vendor to furnish test report for verification | | |
| | | Soundness of packing | MA | Visual | 100% | BHEL Spec. | BHEL Spec. | Log Book | 3/2 | 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 | |
|---|--|---|--|--|--|

92

148

| STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR AND THERMOWELL | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1025 | | | |
|--|--------------------------|---|------------|---------------------------------------|------------------|--------------------------------------|--------------------------------------|-------------------|----------|--------------------------------------|------|--|--|
| | | | | | | | | | | VOLUME IIB | | | |
| | | | | | | | | | | SECTION D | | | |
| | | | | | | | | | | REV. NO. 00 | | | |
| | | | | | | | | | | DATE: 15.03.99 | | | |
| | | | | | | | | | | SHEET 1 OF 2 | | | |
| 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 | | |
| 1.0 | Raw Material / Component | | | | | | | | | | | | |
| 1.1 | Resistance sheath | Material composition | CR | Chemical testing | Sample | Approved data sheet, BHEL Spec. | Relevant material std. | Test Certificate | 3,2 | — | 2,1* | ▲ Relevant compliance certificate to be verified. | |
| 1.2 | Protective Sheath | Material composition | MA | Chemical testing | Sample | Approved data sheet, BHEL Spec. | Relevant material std. | Test Certificate | 3,2 | — | 2,1* | | |
| 1.3 | Terminal Head | Material composition | MA | Chemical testing | Sample | Approved data sheet, BHEL Spec. | Relevant material std. | Test Certificate | 3,2 | — | 2,1* | | |
| 1.4 | Thermowell⊕ | 1. Chemical properties | CR | Chemical composition | One sample / Lot | Approved data sheet, BHEL Spec. | Relevant material std. | Test Certificate | 3,2 | — | 2,1 | | |
| | | 2. Dimensions (wall thickness concentricity of bore, OD & length) | MA | Measurement | 100% | Approved drg., BHEL Spec. | Approved drg., BHEL Spec. | Inspection report | 2 | 1* | 1 | ▲ BHEL to witness 25% Samples | |
| | | 3. Threading | MA | Thread matching | 100% | Approved data sheet/drg., BHEL Spec. | Approved data sheet/drg., BHEL Spec. | Inspection Report | 2 | 2,1* | 1 | | |
| | | 4. Leak Test | CR | Hydro test at 1.5 times design press. | 100% | Approved drg., BHEL Spec. | Approved drg., BHEL Spec. | Inspection Report | 3,2 | 2/1 | — | ⊖ IBR certificate wherever specified to be verified. | |
| 2.0 | Final Inspection | | | | | | | | | | | | |
| 2.1 | RTD Assembly | 1. Workmanship | MA | Visual | 100% | BHEL Spec. | BHEL Spec. | Log Book | 2 | 2,1* | 1 | | |
| | | 2. Marking | MA | Visual | 100% | BHEL Spec. | BHEL Spec. | Log Book | 2 | 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 | | |
|---|--|--|--|--|--|--|--|--|


49

| STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR AND THERMOWELL | | | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1025 | | | |
|--|-----------------------|----------------------------------|------------|----------------------|-----------------|-----------------------|----------------------------------|-------------------|-----------|------|---|--------------------------------------|--|--|--|
| | | | | | | | | | | | | VOLUME IIB | | | |
| | | | | | | | | | | | | SECTION D | | | |
| | | | | | | | | | | | | REV. NO. 00 | | | |
| | | | | | | | | | | | | DATE: 15.03.99 | | | |
| | | | | | | | | | | | | SHEET 2 OF 2 | | | |
| 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 | | | | |
| 2.2 | Routine Tests | 3. Dimensions | MA | Measurement | 100% | BHEL Spec. | BHEL Spec. | Log Book | 2 | 2,1* | 1 | | | | |
| | | 1. Calibration (Resis Vs. Temp.) | * CR | Measurement | 100% | Approved drg. IS:2848 | BHEL Spec. IS:2848 | Test Report | 2 | 2 | 1 | | | | |
| | | 2. Insulation Resistance | MA | Electrical | 100% | IS:2848 | IS:2848 | Test Report | 2 | 1 | — | | | | |
| | | 3. Resistance Tolerance | MA | Thermal Elect. | 100% | IS:2848 | IS:2848 | Test Report | 2 | 1 | — | | | | |
| 2.3 | Type Test | 4. Thermal Response time | CR | Measurement | Sample | IS:2848 | IS:2848 | Test Certificate | 2 | 1 | — | | | | |
| | | 1. Immersion error Test | MA | Measurement | Sample | IS:2848 | IS:2848 | Test Certificate | 3/2 | — | 1 | | | | |
| | | 2. Thermoelectric Effect | MA | Measurement | Sample | IS:2848 | IS:2848 | Test Certificate | 3/2 | — | 1 | | | | |
| | | 3. Vibration Test | CR | Measurement | Sample | IS:2848 | IS:2848 | Test Certificate | 3/2 | — | 1 | | | | |
| 3.0 | Packing | 4. Enclosure protection test | CR | | Sample | BHEL Spec. | BHEL Spec., Approved data sheet. | Test Certificate | 3/2 | — | 1 | • Test certificates to be verified. | | | |
| | | Soundness of packing | MA | Visual | 100% | BHEL Spec. | BHEL Spec. | Log Book | 3/2 | 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 | |
|---|--|---|--|--|--|

150

99

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR LEVEL SWITCHES | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1033 | | | |
|--|-------------------------------|---|------------|--------------------------------|-----------------|--|---|----------------------------|----------|---|------|--|--|--|--|
| | | | | | | | | | | | | VOLUME IIB | | | |
| | | | | | | | | | | | | SECTION D | | | |
| | | | | | | | | | | | | REV. NO. 00 DATE: 15.03.99 | | | |
| | | | | | | | | | | | | SHEET 1 OF 3 | | | |
| 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 | | | | |
| 1.0 | Raw Material/ Component | | | | | | | | | | | | | | |
| 1.1 | Non Wetted Parts | Physical, Chemical properties | MA | Physical, Chemical Analysis | 1/ Cast | BHEL Spec/ Approved drg. / data sheet | Relevant material standard | Test Report | 3/2 | — | 2,1* | *Relevant compliance certificate to be verified. | | | |
| 1.2 | Float Assembly & Wetted Parts | Physical for float only & chemical properties for all wetted parts including float assembly | MA | Physical, Chemical Analysis | 1/ Batch | AISI:316 / BHEL spec. / drg. / Approved data sheet | AISI:316 / BHEL spec. / drg. / Approved data sheet / Relevant material std. | Test Certificate | 3/2 | — | 2,1* | | | | |
| 1.3 | Chamber | Dimensions & leak tightness | MA | Measurement, visual, hyd. test | 100% | BHEL Spec/ Approved drg. / data sheet | BHEL Spec/ Approved drg. / data sheet | Internal inspection report | 3/2 | 2 | 1 | | | | |
| 1.4 | Float | Leak tightness | MA | Hyd. test | 100% | BHEL Spec/ Approved drg. / data sheet | No leakage | Internal inspection report | 3/2 | 2 | 1 | | | | |
| 1.5 | Switch | 1.. Make, type and rating | MA | Visual | 100% | BHEL / Mfr. spec. | BHEL / Mfr. spec. | Internal inspection report | 3/2 | — | 2,1 | | | | |
| | | 2. Contact Continuity | CR | Electrical | 100% | BHEL / Mfr. spec. | BHEL / Mfr. spec. | To have continuity | 3/2 | — | 2,1 | | | | |
| 2.0 | Final Inspection | | | | | | | | | | | | | | |
| 2.1 | Assembly | 1. Marking: Range, Model, Tag No. Sl.No. | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | — | | | | |

| | | | | | | |
|---------|------|----------------------------|---|-------------------------------|---|--------------|
| LEGEND: | * CR | - Critical characteristics | P | - Agency Performing the Test. | 1 | - BHEL |
| | MA | - Major characteristics | W | - Agency Witnessing the Test. | 2 | - Vendor |
| | MI | - Minor characteristics | V | - Agency Verifying the Test. | 3 | - Sub-vendor |


15

| <div><div><div>भारतीय विद्युत निगम</div><div>BHEL</div></div><div>PEM : C&I</div></div> <div>STANDARD QUALITY PLAN FOR LEVEL SWITCHES</div> | | QUALITY PLAN NO.: PE-QP-999-145-1033 | | | | | | | | | | | | | |
|---|--------------|---|-----------------------|-------------------------|------------|----------------------------------|----------------------------------|---------------------|------------------|-------------------|-----------|------------------------------|---|----------------|--|
| | | VOLUME | | IIB | | SECTION | | D | | REV. NO. | | 00 | | DATE: 15.03.99 | |
| | | SHEET | | 2 | | OF | | 3 | | | | | | | |
| | | 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 | | |
| 2.2 | Routine Test | 2. Correct assembly, workmanship and finish | MA | Visual | 100% | Manufacturer standard | Manufacturer standard | Log Book | 2 | 1 | — | | | | |
| | | 3. Connection | MA | Visual & Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | — | | | | |
| | | 4. Scale Marking | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | — | | | | |
| | | 5. Cleanliness | MA | Visual | 100% | Manufacturer standard | Free from scratches dirt etc. | Log Book | 2 | 1 | — | | | | |
| | | 6. Overall Dimension | MA | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection Report | 2 | 1 | — | | | | |
| | | 1. Overload | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1❖ | 1 | ❖BHEL to witness 25% sample. | | | |
| | | 2. Repeatability | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1❖ | 1 | | | | |
| | | 3. Set point adjustment | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test Report | 2 | 1❖ | 1 | | | | |
| | | | | | | | | | | | | | | | |

| | | | | | |
|-----------|--|----|----------------------------|---|--------------|
| LEGEND: * | | CR | - Critical characteristics | 1 | - BHEL |
| | | MA | - Major characteristics | 2 | - Vendor |
| | | MI | - Minor characteristics | 3 | - Sub-vendor |

152

8


|  PEM :: C&I | | STANDARD QUALITY PLAN FOR THERMOCOUPLE WITH THERMOWELL | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-I003 VOLUME IIB SECTION D REV. NO. 00 DATE: 15.03.99 SHEET 1 OF 2 | |
|---|--------------------------|---|------------|--------------------------------------|-----------------|-----------------------------------|-----------------------------------|-------------------|----------|------|------|--|--|
| 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 | | |
| 1.0 | Raw Material / Component | | | | | | | | | | | | |
| 1.1 | Thermocouple wires | Material composition | CR | Chemical testing | Sample | BHEL Specs. / Appd. data sht. | Relevant material standards | Test Certificate | 3/2 | — | 2.1. | ▲ Relevant compliance certificate to be verified. | |
| 1.2 | Protective Sheath | Material composition | MA | Chemical testing | Sample | BHEL Specs. / Appd. data sht. | Relevant material standards | Test Certificate | 3/2 | — | 2.1. | | |
| 1.3 | Terminal Head | Material composition | MA | Chemical testing | Sample | — | Relevant material standards | Test Certificate | 3/2 | — | 2.1. | | |
| 1.4 | Thermowell ⊕ | 1. Chemical properties | CR | Chemical test | Sample | BHEL Specs / Approved data sheet | Relevant material standard | Test Certificate | 3/2 | — | 2.1. | | |
| | | 2. Dimensions (wall thickness concentricity of bore, OD and length) | MA | Measurement | 100% | BHEL Specs / Approved drgs. | BHEL Specs / Approved drgs. | Log Book | 2 | 1. | 1 | | |
| | | 3. Threading | MA | Thread matching | 100% | BHEL Specs / Approved data sheet. | BHEL Specs / Approved data sheet. | Inspection Report | 2 | 2.1. | 1 | | |
| | | 4. Leak Test | CR | Hyd. test at 1.5 times design press. | 100% | BHEL Specs / Approved data sheet. | BHEL Specs / Approved data sheet. | Inspection Report | 3/2 | 2.1 | — | ⊕ IBR certificate if specified to be verified. | |

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

SA


|  STANDARD QUALITY PLAN FOR THERMOCOUPLE WITH THERMOWELL | | QUALITY PLAN NO.: PE-QP-999-145-4003 | | | | | | | | |
|--|-------------------------|---|------------|----------------------|-----------------|----------------------------------|----------------------------------|-------------------|--------------------|-------------------------------|
| PEM :: C&I | | VOLUME IIB | | | | | | | | |
| | | SECTION D | | | | | | | | |
| | | REV. NO. 00 DATE: 15.03.99 | | | | | | | | |
| | | SHEET 2 OF 2 | | | | | | | | |
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency \$ P W V | Remarks |
| 2.0 | Final Inspection | | | | | | | | | |
| 2.1 | Thermocouple Inspection | Workmanship | MA | Visual | 100% | BHEL Specs | BHEL Specs. | Log Book | 2 2,1 1 | •BHEL to witness 25% samples. |
| | | Marking | MA | Visual | 100% | BHEL Specs | BHEL Specs / Approved drgs. | Log Book | 2 2,1 1 | |
| | | Dimensions | MA | Measurement | 100% | BHEL Specs / Approved drgs. | BHEL Specs / Approved drgs. | Log Book | 2 2,1 1 | |
| 2.2 | Routine Tests | 1. Continuity and Polarity | MA | Measurement | 100% | ---- | Compliance | Test Report | 2 2,1 -- | |
| | | 2. Accuracy Test (EMF vs. Temp. | CR | Thermal & Elect | 100% | BHEL Specs | Relevant standards | Test Report | 2 2,1 -- | |
| | | 3. Insulation resistance between Element and sheath | MA | Thermal & Elect | 100% | ---- | Relevant standards | Test Report | 2 1 -- | |
| | | 4. Response Time Test | MA | Thermal & Elect | 10% | BHEL Specs / Approved data sheet | Relevant standards | Test Report | 2 2 1 | |
| 2.3 | Type Tests | Enclosure protection test for Head | CR | Testing | Sample | BHEL Specs | BHEL Specs / Approved data sheet | Test Certificate | 3/2 -- 1 | |
| 3.0 | Packing | Soundness of packing | MA | Visual | 100% | BHEL Spec. | BHEL Spec. | Log Book | 3/2 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


155

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1001 VOLUME IIB SECTION D REV. NO. 00 DATE: 12.10.99 SHEET 1 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 | | | |
| 1.0 | RAW MATERIAL INSPECTION | | | | | | | | | | | | | | |
| 1.1 | Body/Casing, Cable Gland and Mounting Bracket | 1. Chemical & Mech. Properties 2. Dimensions 3. Visual 4. Degree of Protection (If applicable) 5. Leak Tightness | MA | Analysis | 1 / Lot | Tech. Specn. Data Sheet, Mfr. standard | Tech. Specn. Data Sheet, Mfr. standard | Test certificate | 3 | — | 2 | | Compliance report verification by BHEL. | | |
| | | | MA | Measurement | 10% Min. 3 Nos. | Manufacturer drg. | Manufacturer drg. | Log Book | 2 | — | — | | | | |
| | | | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Log Book | 2 | — | — | | | | |
| | | | CR | IS-2147 IS-2148 | 1 / Type | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test certificate | 3 | — | 2 | | | | |
| | | | MA | Hydro Test | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Log Book | 2 | — | — | | | | |
| 1.2 | Sensor (Diaphragm, Capsule, Bellows, Strain, Gauge, Capacitance etc.) | 1. Material Properties (Chemical & Mechanical) 2. Dimension 3. Performance 4. Type Test | MA | Analysis | 1 / Lot | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test certificate | 3/2 | — | 2 | | | | |
| | | | MA | Measurement | 1 / Lot | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test certificate | 2 | — | — | | | | |
| | | | CR | Function | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test certificate | 2 | — | — | | | | |
| | | | CR | Mech. & Elect. | 1/Type | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Test certificate | 3/2 | — | 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 or their agent
 2 - Vendor
 3 - Sub-vendor

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1001 | | | |
|---|------------------------------------|---|-----------------------|-------------------------|------------------|-----------------------|-----------------------|---------------------|------------------|-------------------|-----------|--------------------------------------|---|---------|--|
| | | 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 | |
| 1.3 | Gasket | 1. Dimension | MA | Measurement | Sample | Manufacturer standard | Manufacturer standard | Test certificate | 3/2 | — | 2 | | | | |
| 1.4 | Electrical & Electronic Components | 2. Shear Hardness | MA | Analysis | Sample | Manufacturer standard | Manufacturer standard | Test certificate | 3/2 | — | 2 | | | | |
| | | 1. Marking & Rating | MA | Visual | 10% | Manufacturer standard | Manufacturer standard | Log Book | 2 | — | — | | | | |
| | | 2. Electrical Parameters | CR | Electrical Tests | 10% | Manufacturer standard | Manufacturer standard | Log Book | 2 | — | — | | | | |
| | | 3. Dimensions | MA | Measurement | 10% | Manufacturer standard | Manufacturer standard | Log Book | 2 | — | — | | | | |
| 1.5 | PCBs | 4. Solderability | MA | Electrical | 3 / Type | Manufacturer standard | Manufacturer standard | Log Book | 2 | — | — | | | | |
| | | 1. Visual | MA | Visual | 100% | — | — | — | 3/2 | — | 2 | | | | |
| | | 2. Dimensions | MA | Measurement | 10% | Manufacturer standard | Manufacturer standard | Log Book | 3/2 | — | 2 | | | | |
| | | 3. Type Test | CR | Mech. & Elect. Tests | 1 / Type / Batch | IS:7405 BS:4025 | IS:7405 BS:4025 | Test certificate | 3/2 | — | 2 | | | | |

| | | | | | |
|--------------|----------------------------|---|-------------------------------|---|-----------------------|
| LEGEND: * CR | - Critical characteristics | P | - Agency Performing the Test. | 1 | - BHEL or their agent |
| MA | - Major characteristics | W | - Agency Witnessing the Test. | 2 | - Vendor |
| MI | - Minor characteristics | V | - Agency Verifying the Test. | 3 | - Sub-vendor |

157



PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001

VOLUME IIB

SECTION D

REV. NO. 00 DATE: 12.10.99


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 |
|--|----------------------------------|--|----------------------|---|----------------------------------|--|--|--|------------------|------------------|------------------|------------------|--|
| | | | | | | | | | P | W | V | V | |
| 2.0 | In-Process Inspection | | | | | | | | | | | | |
| 2.1 | Electrical Unit | | | | | | | | | | | | |
| 2.1.1 | Etched PCB | 1. Dimension – Trade width, Gap etc. 2. Defect of undercuts 3. Quality and plating of plating through holes. 4. Screen printing | MA MA CR CR | Measurement Visual Visual Visual | Sample Sample 100% 100% | Manufacturer standard Manufacturer standard Manufacturer standard Manufacturer standard | Manufacturer standard Manufacturer standard Manufacturer standard Manufacturer standard | Inspection report Inspection report Inspection report Inspection report | 2 2 2 2 | — — — — | — — — — | — — — — | Compliance verification report by BHEL |
| 2.1.2 | Component Mounting and soldering | 1. Correctness of components 2. Mounting and orientation 3. Soldering defects and finish | MA MA CR | Visual Visual Visual | 100% 100% 100% | Manufacturer standard Manufacturer standard Manufacturer standard | Manufacturer standard Manufacturer standard Manufacturer standard | Inspection report Inspection report Inspection report | 2 2 2 | — — — | — — — | — — — | |
| 2.1.3 | Assembled PCBs | Functional check | CR | Electrical checks before & after soaking* | 100% | Manufacturer standard | Manufacturer standard | Inspection report | 2 | — | — | — | |
| <p>*Soaking means subjecting PCB (Assembled) at 70 Deg. C for 72 hours at energised condition and rapid temperature cycle test at 70 Deg. C and (-) 20 Deg. C for 30 minutes at each temp. (Five such cycles).</p> | | | | | | | | | | | | | |

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 or their agent
 2 - Vendor
 3 - Sub-vendor

|  STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER | | QUALITY PLAN NO.: PE-QP-999-145-1001 | | | | | | | | | | | | |
|---|--|--|-----------------------|-------------------------|------------|-----------------------|-------------------|---------------------|------------------|-------------------|--|--|--|---------|
| | | VOLUME IIB | | | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | | | |
| | | REV. NO. 00 DATE: 12.10.99 | | | | | | | | | | | | |
| SHEET 4 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 | | | |
| 2.1.4 | Conformal coating | Uniformity and finish of conformal coating on both sides | CR | Visual | 100% | Manufacturer standard | Inspection report | 2 | --- | --- | Compliance verification report by BHEL | | | |
| 2.2 | Mounting, Fitting, Assembly of various mechanical parts | 1. Correct Mounting | MA | Visual | 100% | Manufacturer standard | Log Book | 2 | --- | --- | | | | |
| | | 2. Defects | MA | Visual | 100% | Manufacturer standard | Log Book | 2 | --- | --- | | | | |
| | | 3. Dimensions | MA | Measurement | 100% | Manufacturer standard | Log Book | 2 | --- | --- | | | | |
| 2.3 | Interconnection – Sensor to Electronic unit | Correctness of Interconnection | MA | Visual | 100% | Manufacturer standard | Log Book | 2 | --- | --- | | | | |
| 2.4 | Interconnection – Pneumatic unit / Electronic unit and output / Local indicator. | Correctness of Interconnection | MA | Visual | 100% | Manufacturer standard | Log Book | 2 | --- | --- | | | | |

| | | |
|---|---------------------------------|-------------------------|
| LEGEND: * CR - Critical characteristics | P - Agency Performing the Test. | 1 - BHEL or their agent |
| MA - Major characteristics | W - Agency Witnessing the Test. | 2 - Vendor |
| MI - Minor characteristics | V - Agency Verifying the Test. | 3 - Sub-Vendor |

154



PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001

VOLUME IIB

SECTION D

REV. NO. 00 DATE: 12.10.99

SHEET 5 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 | |
| 3.0 | Complete Transmitter | 1. Workmanship | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 2. Dimension | MA | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 3. Type / Model | CR | Visual | 10% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 4. Range | CR | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 5. Calibrated Range | CR | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 6. Local Indicator / Scale marking | MA | Visual | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 7. Process connection type | CR | Measurement | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 8. Wetted parts material | MA | Analysis (Chemical, Mechanical) | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | — | 1 | |
| | | 9. Mounting bracket type | MA | Visual / Dimension | 10% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 10. Calibration | CR | Electrical / Pneumatic | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report / Log Book | 2 | 1 | — | |
| | | 11. Soaking | CR | Electrical | 100% | BHEL Spec | BHEL Spec. | Inspection report / Log Book | 2 | 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.


86

67


|  STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER | | QUALITY PLAN NO.: PE-QP-999-145-1001 VOLUME IIB SECTION D REV. NO. 00 DATE: 12.10.99 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 ³ | | | Remarks |
| | | | | | | | | | P | W | V | |
| 3.2 | Acceptance Tests | 1. Accuracy | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |
| | | 2. Repeatability | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |
| | | 3. Dead Band | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |
| | | 4. Hysteresis | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |
| | | 5. HV & IR | CR | Electrical | 100% | Manufacturer standard | Manufacturer standard | Inspection report | 2 | 1 | 1 | |
| | | 6. Linearity | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |
| | | 7. Supply voltage variation effect | CR | Electrical | 100% | BHEL Spec. | BHEL Spec. | Inspection report | 2 | 1 | 1 | |
| | | 8. Temperature variation effect over range | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |
| | | 9. Over range | CR | Electrical | 100% | BHEL Spec. / Approved data sheet | BHEL Spec. / Approved data sheet | Inspection report | 2 | 1 | 1 | |

| | | |
|---|--|---|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | 3 P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. | 1 - BHEL or their agent 2 - Vendor 3 - Sub-vendor |
|---|--|---|

10

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-I001 VOLUME IIB SECTION D REV. NO. 00 SHEET 7 OF 7 DATE: 12.10.99 | | | |
|---|-----------------------|---|------------|----------------------|-----------------|-----------------------|-----------------------|-------------------|----------|---|-----|--|--|-----------------------|--|
| 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 | | | | |
| 3.3 | Type Test | 1. Surge withstand capability 2. Radio frequency interference 3. Vibration effect 4. Electro Magnetic field effect 5. Degree of protection 6. Explosion proofness (if applicable) 7. Dry Heat 8. Damp Heat | CR | Elect. & Mech | 1 / Type | ANSI-C.37 | ANSI-C.37 | Inspection Report | 3 | — | 2,1 | | | | |
| | | | CR | Elect. & Mech | 1 / Type | ANSI-C.37 | ANSI-C.37 | Inspection Report | 3 | — | 2,1 | | | | |
| | | | CR | Elect. & Mech | 1 / Type | BHEL Spec. | BHEL Spec. | Inspection Report | 3 | — | 2,1 | | | | |
| | | | CR | Elect. & Mech | 1 / Type | BHEL Spec. | BHEL Spec. | Inspection Report | 3 | — | 2,1 | | | | |
| | | | CR | Mech. & Elect. | 1 / Type | IS:2147 | BHEL Spec. | Inspection Report | 3 | — | 2,1 | | | | |
| | | | CR | Mech. & Elect. | 1 / Type | IS:2148 | BHEL Spec. | Inspection Report | 3 | — | 2,1 | | | | |
| | | | CR | Thermal | 1 / Type | IS:9000 | ANSI-C.37 | Inspection Report | 3 | — | 2,1 | | | 85 Deg. C for 16 Hrs. | |
| | | | CR | Thermal | 1 / Type | IS:9000 | ANSI-C.37 | Inspection Report | 3 | — | 2,1 | | | 40 Deg. C; 6 cycle | |
| 4.0 | Packing | 1. Packing Material 2. Packaging and Marking | MA | Visual | 100% | Manufacturer standard | Manufacturer standard | Log Book | 2 | — | 2 | | | | |
| | | | MA | Visual & Measurement | 100% | Manufacturer standard | Manufacturer standard | 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 or their agent 2 - Vendor 3 - Sub-vendor | |
|---|--|--|--|---|--|

|  STANDARD QUALITY PLAN FOR LEVEL GAUGES | | QUALITY PLAN NO.: PE-QP-999-145-1028 | | | | | | | | | | |
|--|--|--|------------|---|--------------------------------------|--|--|---|-----------------------|-----------------------|-----------------------|--|
| | | VOLUME IIB | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | |
| | | REV. NO. 00 DATE: 01.11.2000 | | | | | | | | | | |
| | | SHEET 1 OF 2 | | | | | | | | | | |
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency ⁵ | | | Remarks |
| | | | | | | | | | P | W | V | |
| 1.0 | Material / Components | | | | | | | | | | | |
| 1.1 | Body, Cover, Interns, Flanges, Gaskets | 1. Physical, Chemical Properties 2. Workmanship, finish and dimensions | MA | Physical, Chemical Test Visual, Measurement | One Sample from each lot 100% | Approved drg. / data sheet / BHEL Spec. Manufacturing standards / drgs. | Approved drg. / data sheet / BHEL Spec. Manufacturing standards / drgs. | Test Certificate Inspection Report / Log Book | 3/2 | — | 2,1# | # Compliance certificate to be verified. |
| 1.2 | Glass Tube | Strength, Transparency, dimensions | MA | Toughness & Thermal shock, Visual, Measurement | one sample from each lot | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Test Certificate/ Inspection Report | 3 | — | 2,1# | |
| 2.0 | Assembly | 1. Marking – Tag No., Model, Range 2. Workmanship 3. Scale graduation 4. Glass Opaque painting 5. Dimensions and end connections | MA | Visual Visual Visual Visual Measurement | 100% 100% 100% 100% 100% | - do - - do - - do - - do - - do - | - do - - do - - do - - do - - do - | Inspection Report - do - - do - - do - - do - | 2 2 2 2 2 | 1 1 1 1 1 | — — — — — | For Reflex type |
| 3.0 | Routine Test | 1. Calibration 2. Hydro Test | CR | Measurement Measurement | 100% 100% | - do - - do - | - do - - do - | - do - - do - | 2 2 | 1** 1** | 1 1 | **10% quantity with minimum of 1 piece / type & size |

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

⁵ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

63


| STANDARD QUALITY PLAN FOR LEVEL GAUGES | | | | | | | | | | |
|--|-----------------------|--|------------|----------------------|-----------------|---|---|-------------------|------------------------|---------|
| PEM :: C&I | | QUALITY PLAN NO.: PE-QP-999-145-1028 VOLUME IIB SECTION D REV. NO. 00 DATE: 01.11.2000 SHEET 2 OF 2 | | | | | | | | |
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency \$ P W V | Remarks |
| 4.0 | Painting | Shade & Finish | MA | Visual | 100% | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Inspection Report | 2 1** 1 | |
| 5.0 | Packing | Soundness | MA | Visual | 100% | - do - | - do - | - do - | 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

164


|  PEM :: C&I | | STANDARD QUALITY PLAN FOR TEMPERATURE GAUGE AND THERMOWELL | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1027 VOLUME IIB SECTION D REV. NO. 01 DATE: 16-05-2007 SHEET 1 OF 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 | | | | |
| 1.0 | Raw Material / Component | | | | | | | | | | | | | | |
| 1.1 | Capillary Bulb and Thermowell | 1. Chemical composition | CR | Chemical analysis | one sample/lot | BHEL spec. / approved data sheet | Relevant raw material std. | Test report | 3/2 | — | 2,1 | Relevant compliance certificate to be verified by BHEL | | | |
| | | 2. Marking, | MA | Visual | 100% | BHEL spec. / Mfr. Standard | BHEL spec. / Mfr. Standard | Log Book | 2 | — | — | | | | |
| | | 3. Dimensions | MA | Measurement | 100% | BHEL spec. / approved doc | BHEL spec. / approved doc | Log Book | 2 | — | — | | | | |
| 1.2 | Casing and Bezel | 1. Material | MA | Chemical analysis | Sample | BHEL spec. | BHEL spec. | Test report | 3/2 | — | 2,1 | Relevant compliance certificate to be verified by BHEL | | | |
| | | 2. Defects | MA | Visual | 100% | Mfr. Standard | Mfr. Standard | Log Book | 2 | — | — | | | | |
| | | 3. Dimension | MA | Measurement | Sample | BHEL spec. / approved doc. | BHEL spec. / approved doc. | Log Book | 2 | — | — | | | | |
| | | 4. Threading | MA | Thread matching | 100% | —do— | —do— | Log Book | 2 | — | — | | | | |
| 1.3 | Dial | 1. Size, range, scale length, least-count, spacing and graduation. | MA | Measurement and Visual | Sample | BHEL spec. | BHEL spec. | Log Book | 2 | — | — | | | | |
| | | 2. Colour | MA | Visual | 100% | BHEL spec. | BHEL spec. | Log Book | 2 | — | — | | | | |
| | | 3. Resistance to dry heat and hot water | MA | Oven & Bath | Sample | Mfr. Standard | Mfr. Standard | Test report | 3/2 | — | — | | | | |

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

165

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR TEMPERATURE GAUGE AND THERMOWELL | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1027 | | | |
|---|--------------------------|---|------------|--|-----------------|---|---|-------------------|----------|----------|---|--------------------------------------|--|------------------|--|
| | | VOLUME | | IIB | | SECTION | | D | | REV. NO. | | 01 | | DATE: 16-05-2007 | |
| | | SHEET | | 2 | | OF | | 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 | | | | |
| 1.4 | Complete sensing element | 1. Correct assembly and workmanship. | MA | Visual | 100% | Mfr. Standard drawing | Mfr. Standard drawing | Log Book | 2 | — | — | — | | | |
| | | 2. Dimensions | MA | Measurement | 100% | Mfr. Standard drawing | Mfr. Standard drawing | Log Book | 2 | — | — | — | | | |
| | | 3. Welding & other defects | MA | Visual | 100% | Mfr. Standard | Mfr. Standard | Log Book | 2 | — | — | — | | | |
| 1.5 | Thermowell ⊕ | 1. Dimensions of wall thickness, concentricity of bore OD & Length. | MA | Measurement | 100% | BHEL spec. / approved data sheet / Drg. | BHEL spec. / approved data sheet / Drg. | Log Book | 2 | 1 | 1 | 1 | BHEL to witness 10 % random samples. | | |
| | | 2. Leak Test | CR | Hyd. test at 1.5 times of design pressure. | 100% | BHEL spec. / approved data sheet / Drg. | BHEL spec. / approved data sheet / Drg. | Inspection report | 3/2 | 2,1 | 1 | 1 | ⊕ IBR cert. wherever specified to be verified. | | |
| | | 3. Threading | MA | Thread matching | 100% | BHEL spec. / approved data sheet / Drg. | BHEL spec. / approved data sheet / Drg. | Inspection report | 2 | 2,1 | 1 | 1 | BHEL to witness 10% samples. | | |
| 2.0 | Final Inspection | | | | | | | | | | | | | | |
| 2.1 | Assembly | 1. Correct assembly, workmanship and finish | MA | Visual | 100% | BHEL spec. / approved data sheet | BHEL spec. / approved data sheet | Inspection report | 2 | 1 | — | — | | | |

| | | | | | |
|---|--|--|--|--|--|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | | \$ P W V - Agency Performing the Test. - Agency Witnessing the Test. - Agency Verifying the Test. | | 1 - BHEL 2 - Vendor 3 - Sub-vendor | |
|---|--|--|--|--|--|


166

|  PE :: C&I | | STANDARD QUALITY PLAN FOR TEMPERATURE GAUGE AND THERMOWELL | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1027 VOLUME IIB SECTION D REV. NO. 01 DATE: 16-05-2007 SHEET 3 OF 4 | | | |
|--|-----------------------|--|------------|------------------------|-----------------|---|-----------------------------------|-------------------|----------|-----|---|--|--|--|--|
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency's | | | Remarks | | | |
| | | | | | | | | | P | W | V | | | | |
| | | 2. Mounting and connection | MA | Visual and measurement | 100% | do | do | Inspection report | 2 | 1 | 1 | --- | | | |
| | | 3. Dial Scale | MA | Visual | 100% | do | do | Log Book | 2 | 1 | 1 | --- | | | |
| | | 1. Cleanliness | MA | Visual | 100% | do | Free from scratches, dirt etc. | Log Book | 2 | --- | 2 | | | | |
| | | 5. Marking (S.No., Tag No.) | MA | Visual | 100% | BHEL spec. / approved data sheet | BHEL spec. / approved data sheet | Log Book | 2 | 1 | 1 | --- | | | |
| 2.2 | Routine Test | 1. Accuracy | MA | Measurement | 100% | BHEL spec. / Approved data Sheet. | BHEL spec. / Approved data Sheet. | Test Report | 2 | 1 | 1 | BHEL to witness 10% random Samples. | | | |
| | | 2. Overload | CR | Measurement | 10% | 125% of FSD for range upto 400 Deg. C. 110% of FSD for range between 400 to 500 Deg. C. 100% of FSD for range above 500 Deg. C. | No Damage | Test 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


|  STANDARD QUALITY PLAN FOR TEMPERATURE GAUGE AND THERMOWELL | | QUALITY PLAN NO.: PE-QP-999-145-J027 | | | | | | | | |
|--|-----------------------|---|------------|----------------------|-----------------|---|-----------------------------------|-------------------|-------------------|--|
| VOLUME IIB | | SECTION D | | | | | | | | |
| REV. NO. 01 | | DATE: 16-05-2007 | | | | | | | | |
| SHEET 4 | | OF 4 | | | | | | | | |
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency : P W V | Remarks |
| | | 3. Response Time | MA | Measurement | 10% | ASME PTC19.3 | ASME PTC19.3 | Test Report | 2 1 1 | BHEL to witness 10% random samples. |
| 2.3 | Type Test | 1. Ambient temperature compensation 0-60 Deg. C | MA | Measurement | Sample | Bulb at constant temp. & case temp varied 0-60 Deg. C | No variation in measurement | Test Certificate | 2 -- 1 | Existing test certificate (Not more than 5 year old) shall be furnished. |
| | | 2. Weather proofness | CR | Measurement | Sample | BHEL spec. / Approved data sheet. | BHEL spec. / Approved data sheet. | Test Certificate | 3/2 -- 1 | --do-- |
| 3.0 | Packing | Soundness of packing | MA | Visual | 100% | BHEL Spec. | BHEL Spec. | Log Book | 3/2 2 -- | Refer Note-1 |

Note: 1. In the absence of BHEL specification for painting, vendor to obtain BHEL's approval on their painting specification / procedure.

| | | | | | | |
|-----------|----|----------------------------|---|-------------------------------|---|--------------|
| LEGEND: * | CR | - Critical characteristics | P | - Agency Performing the Test. | 1 | - BHEL |
| | MA | - Major characteristics | W | - Agency Witnessing the Test. | 2 | - Vendor |
| | MI | - Minor characteristics | V | - Agency Verifying the Test. | 3 | - Sub-vendor |

168


82

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR TEMPERATURE SWITCH | | | | | | | | | | QUALITY PLAN NO.: PS-QP-999-145-I032 VOLUME IIB SECTION D REV. NO. 00 DATE: 02.11.2000 SHEET 1 OF 2 | | | |
|---|--|--|------------|-------------------------|--------------------------|---|---|------------------------------|-----------|-----|-------|--|--|--|--|
| 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 | | | | |
| 1.0 | Material / Components | | | | | | | | | | | | | | |
| 1.1 | Casing, Sensing Element and Thermowell | 1. Physical, Chemical Properties 2. Workmanship, finish and dimensions | MA | Physical, Chemical Test | One Sample from each lot | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Test Certificate | 3/2 | — | 2, 1# | # Compliance certificate to be verified. | | | |
| 1.2 | Switch | Contact type & no. | MA | Visual | 100% | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Inspection Report / Log Book | 3 | — | 2, 1# | | | | |
| 2.0 | Assembly | 1. Marking – Tag No., Model, Range 2. Workmanship 3. Scale graduation 4. Dimensions and end connections | MA | Visual | 100% | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Inspection Report | 2 | 1 | — | | | | |
| | | | MA | Visual | 100% | - do - | - do - | - do - | 2 | 1 | — | | | | |
| | | | MA | Visual | 100% | - do - | - do - | - do - | 2 | 1 | — | | | | |
| | | | MA | Measurement | 100% | - do - | - do - | - do - | 2 | 1** | 1 | **25% quantity with minimum of 1 piece / type & size | | | |
| 3.0 | Routine Test | 5. Switch – contact type & nos. 1. Calibration, accuracy, repeatability, overload, set point adjustment, differential | MA | Visual | 100% | Approved drg. / data sheet / BHEL Spec. | Approved drg. / data sheet / BHEL Spec. | Inspection Report | 2 | 1** | 1 | | | | |
| | | | CR | Measurement | 100% | - do - | - do - | - do - | 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



PEM :: C&I

STANDARD QUALITY PLAN FOR TEMPERATURE SWITCH

QUALITY PLAN NO.: PS-QP-999-145-1032

VOLUME IIB

SECTION D

REV. NO. 00 DATE: 02.11.2000

SHEET 2 OF 2


| 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 | |
| 4.0 | Type Test | 2. Hydro Test | CR | Measurement | 100% | Approved drg. / data sheet / BHEL Spec. | No Leakage | Inspection Report | 2 | 1** | 1 | |
| | | 3. IR, HV | CR | Measurement | 100% | - do - | Approved drg. / data sheet / BHEL Spec. | - do - | 2 | 1** | 1 | |
| | | 1. Enclosure Protection Class (weather proof-ness, explosion proof-ness, etc.) | CR | Verification | Each type | - do - | - do - | Test Certificate | 2 | — | 1• | •Type Test Certificate to be verified |
| 5.0 | Painting | 2. Ambient temperature compensation (0 - 60°C) | CR | Verification | Each type | - do - | - do - | - do - | 2 | — | 1• | |
| | | 3. Switch contact rating | CR | Verification | Each type | - do - | - do - | - do - | 2 | — | 1• | |
| 6.0 | Packing | Shade & Finish | MA | Visual | 100% | - do - | - do - | Inspection Report | 2 | 1** | 1 | |
| | | Soundness | MA | Visual | 100% | - do - | - do - | - do - | 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

071

|  STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY | | QUALITY PLAN NO.: PE-QP-999-145-1005 | | | | | | | | | | |
|--|---|--|------------|-------------------------------------|---------------------------|--------------------------------------|---------------------------|---------------------|----------|---|-----|---|
| | | VOLUME IIB | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | |
| | | REV. NO. 04 | | DATE: 12.09.2011 | | | | | | | | |
| | | SHEET 1 | | OF 3 | | | | | | | | |
| 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 | |
| 1.0 | RAW MATERIAL Flow Nozzle, pipe, adapter | Physical, Chemical properties | MA | Physical, Chemical tests | One / Heat | AP / DP / SP | AP / DP / SP | TC | 3/2 | — | 2,1 | Refer Note-1 |
| | | Ultrasonic testing (nozzle only) | MA | Ultrasonic test | 100% | ASTMA388 & ANSI B 16.34 | ASTMA388 & ANSI B 16.34 | TC | 3 | 2 | 1 | |
| 2.0 | IN PROCESS | | | | | | | | | | | |
| 2.1 | Welding procedure specification (WPS) | Correctness | MA | Scrutiny | 100% | IS:7307 / ASME IX | IS:7307 / ASME IX | Format of IS / ASME | 3/2 | — | 2,1 | IBR certification to be verified by BHEL, if applicable |
| 2.2 | Procedure Qualification Record(PQR) & Welders qualification | Weld soundness | MA | Physical test / Radiographic Test | IS:7307/ IS:7310/ ASME IX | IS:7307/ IS:7310/ ASME IX | IS:7307/ IS:7310/ ASME IX | Format of IS / ASME | 3/2 | 2 | 1 | Welding to be done by qualified welders. |
| 2.3 | Weld FIT-UPS | Dimension, Alignment, Orientation. | MA | Measurement & Visual | 100% | WPS/Approved drg. | WPS/Approved drg. | IR / Log Book | 3/2 | — | 2 | Refer Note-3 |
| 2.4 | Weldments final run | 1. Surface defects 2. Sub Surface defects(After PWHT) | MA | Penetrant Test Radiographic Test | 100% | IS:3658 / ASTM 165/ ASME VIII Div. I | ASTM / 165ASME VIII Div I | IR / Log Book | 3/2 | 2 | 1 | 100% by Vendor, 10 % by BHEL |
| | | | MA | | 100% | ASME SEC. V | ASME SEC. VIII | IR | 3/2 | 2 | 1 | Films to be reviewed by BHEL. |

| | | | | | | |
|--|--|---|-------------------------------------|--|--|--|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | | IR - Inspection Reports TC - Test Certificates AP - Approved Drawings/doc | DS - Data Sheet SP - Tech. Spec. | MR - Manufacturer records MS - Manufacturer standards | * P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. | 1 - BHEL 2 - Vendor 3 - Sub-vendor |
|--|--|---|-------------------------------------|--|--|--|

171



PEM :: C&I

STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY

QUALITY PLAN NO.: PE-QP-999-145-1005

VOLUME IIB

SECTION D

REV. NO. 04 DATE: 12.09.2011

SHEET 2 OF 3


| 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 | |
| 2.5 | Machining | 3 Heat Treatment | MA | Review of HT Chart | 100% | ASME SEC. VIII | ASME SEC. VIII | HT Chart | 3/2 | 2 | 1 | 100% by Vendor, 10% by BHEL |
| | 1. Flow Nozzle (machined) | 1. Dimensions | MA | Measurement | 100% | AP / DS | AP / DS | IR | 3/2 | 2 | 1 | |
| | | 2. Profile | MA | Measurement | 100% | AP / DS | AP / DS | IR | 3/2 | 2 | 1 | |
| | | 3. Surface finish | MA | Visual | 100% | ----- | Mirror finish. | IR / Mfd Records | 3/2 | 2 | 1 | |
| | | 1. Machining of pipe ID | MA | Measurement | 100% | AP / DS | AP / DS | IR | 3/2 | 2 | 1 | |
| | 2. Pipe, Adapter | 2. Dimensions | MA | Measurement | 100% | AP / DS | AP / DS | IR | 3/2 | 2 | 1 | |
| | | 3. Surface flaw on weld edge preparation (for shop welding) | MA | Penetrant Test | 100% | ASTM 165/IS-3658 | ASTM 165/IS-3658 | IR / TC | 3/2 | 2 | 1 | |
| | | 4. IBR Clearance | MA | Review | 100% | IBR Compliance | IBR Compliance | Form III C | 3/2 | | 1 | |
| | | 1. Leak tightness | CR | Hydraulic test (1.5 times Design pressure) | 100% | AP / DS | No Leakage | Test Certificate | 3/2 | 2,1 | --- | Minimum time duration of test shall be 1/2 hours. |
| 3.0 | ROUTINE TEST | | | | | | | | | | | |

LEGEND:

- * CR - Critical characteristics
- MA - Major characteristics
- MI - Minor characteristics
- IR - Inspection Reports
- TC - Test Certificates
- AP - Approved Drawings/doc
- DS - Data Sheet
- SP - Tech. Spec.
- MR - Manufacturer records
- MS - Manufacturer standards
- * P - Agency Performing the Test.
- W - Agency Witnessing the Test.
- V - Agency Verifying the Test.
- 1 - BHEL
- 2 - Vendor
- 3 - Sub-vendor

80

172

|  STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY | | QUALITY PLAN NO.: PE-QP-999-145-1005 | | | | | | | | | | | | | | | | | | | |
|--|--------------------|---|----|-------------------------|------|---------------------|--------------------|----------------------|---------|-----------------|---|---------------------|------------------------------|------------------|--|-------------------|--|---------------------|--|---------|--|
| | | VOLUME IIB | | SECTION D | | REV. NO. 04 | | DATE: 12.09.2011 | | SHEET 3 OF 3 | | | | | | | | | | | |
| | | Component / operation | | Characteristics Checked | | * Category | | Type/Method of Check | | Extent of Check | | Reference documents | | Acceptance Norms | | Format of Records | | Agency ¹ | | Remarks | |
| | | | | | | | | | | | | | | | | | | | | | |
| 4.0 | FINAL ASSEMBLY | 2. Calibration | CR | Measurement | 100% | 1 per type per size | --- | Tech Spec. | TC | 2 | 1 | 1 | Refer note-4 | | | | | | | | |
| | | 1. Marking - Tag No., direction of flow | MI | Visual | 100% | 100% | AP / DS | AP / DS | IR | 2 | 1 | 1 | | | | | | | | | |
| | | 2. Workmanship, surface flaw on weld edge preparation on end of pipe (for site welding) | MA | Visual, Penetrant test | 100% | 100% | ASTM165 / IS: 3658 | No Surface Flaw | TC / IR | 3/2 | 2 | 1 | | | | | | | | | |
| | | 3. Dimensions and end connection | MA | Measurement | 100% | 100% | AP / DS | AP / DS | IR | 3/2 | 2 | 1 | Refer Note-2 before dispatch | | | | | | | | |
| 5.0 | PACKING & DISPATCH | Soundness of Packing against transit damage | MA | Visual | 100% | 100% | SP / MS | SP / MS | | 2 | 1 | 1 | Refer Note-5 | | | | | | | | |


NOTE:

1. Test Certificates to be verified by BHEL at final inspection stage.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. In case of NTPC / LLOYOS / BHEL qualified welders available, then prequalification and WPS, PQR not required, only TC to be verified.
4. CALIBRATION Test to be carried out at IIT-DELHI / IIT- MUMBAI / FCRI or BHEL approved laboratory.
5. Sea Worthy packing, if applicable
6. Qualification records of the Vendors can be verified.
7. For P91 & P22 material welding should be continuously done. No interruptions shall be allowed.

173


| | | | | | | | |
|---------|----------------------------|----------------------------|------------------|-----------------------------|----------------------------|---------------------------------|----------------|
| LEGEND: | | | | 1 - BHEL | | | |
| * CR | - Critical characteristics | IR - Inspection Reports | DS - Data Sheet | MR - Manufacturer records | SP - Tech. Spec. | W - Agency Witnessing the Test. | 2 - Vendor |
| MA | - Major characteristics | TC - Test Certificates | SP - Tech. Spec. | MS - Manufacturer standards | AP - Approved Drawings/doc | V - Agency Verifying the Test. | 3 - Sub-vendor |
| MI | - Minor characteristics | AP - Approved Drawings/doc | | | | | |

75

|  STANDARD QUALITY PLAN FOR FLOW ORIFICE PLATE | | QUALITY PLAN NO.: PE-QP-999-145-1024 | | | | | | | | | | |
|--|-------------------------------|---|------------|--------------------------|--------------------------|--|------------------|-----------------------|----------|--------------|-----|--|
| | | VOLUME IIB | | SECTION D | | REV. NO. 04 | | DATE: 12.09.2011 | | SHEET 1 OF 2 | | |
| 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 | |
| 1.0 | MATERIAL | | | | | | | | | | | |
| 1.1 | Orifice Plate | 1. Physical, Chemical properties | MA | Physical, Chemical Tests | One / Plate OR One/ Heat | AP / DS / SP | AP / DS / SP | Lab Report | 3/2 | --- | 2,1 | IBR certification (if applicable) to be verified by BHEL |
| | | 2. Dimensions | MA | Measurement | 100% | AP | AP | IR | 3/2 | | 1 | |
| 1.2 | Flanges | Chemical/Mech Properties, UT & Heat Treatment | MA | Chem & Mech UT test | Sample | Material Spec as per ASTM A 388 for UT | ANSI B 16.34 | MTC, UT cert, HT cert | 3/2 | --- | 1 | |
| | B. Machining | Dimensions | MA | Measurement | 100 % | AP / DS | AP / DS | IR | 3/2 | --- | 1 | |
| 2.0 | IN PROCESS | | | | | | | | | | | |
| | Machine | 1. Dimension | MA | Measurement | 100% | AP | AP | IR | 3/2 | 2 | 2 | |
| | | 2. Surface finish | MA | Visual | 100% | --- | Mirror Finish | --- | 3/2 | 2 | --- | |
| | | 3. Surface flaw on machined surface | MA | Penetrant test | 100% | ASTM 165 / IS:3658 | No surface flaw | IR / TC | 3/2 | 2 | 1 | |
| 3.0 | ASSEMBLY and FINAL INSPECTION | | | | | | | | | | | |
| | | 1. Overall dimensions | MA | Measurement | 100% | AP | AP | IR | 3/2 | 2,1 | --- | |
| | | 2. Marking, Tag no. Direction of flow | MA | Visual | 100% | AP / DS | AP / DS | IR | 3/2 | 2 | 1 | |
| | | 3. Calibration | MA | Performance Test | One per type | --- | SP | TC | 3/2 | --- | 1 | |
| | | 4. Painting | MA | Visual | 100% | SP / MS | SP / MS | IR / MR | 3/2 | --- | 1 | |

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS - Data Sheet MR - Manufacturer records P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics TC - Test Certificates SP - Tech. Spec. MS - Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP - Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor

174


|  STANDARD QUALITY PLAN FOR FLOW ORIFICE PLATE | | QUALITY PLAN NO.: PE-QP-999-145-1024 | | | | | | | | | | |
|--|-----------------------|---|------------|----------------------|-----------------|---------------------|------------------|-------------------|----------|---|---|---------|
| | | VOLUME IIB | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | |
| | | REV. NO. 04 DATE: 12.09.2011 | | | | | | | | | | |
| | | SHEET 2 OF 2 | | | | | | | | | | |
| 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 | |
| 4.0 | PACKING | Soundness of Packing against transit damage | MA | Visual | 100% | SP / MS | SP / MS | — | 3/2 | — | — | |

NOTE:


1. All test reports & dimension reports shall be verified by BHEL wherever verification is by BHEL at the time of Final Inspection.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. CALIBRATION Test to be carried out at IIT-DELHI / IIT- MUMBAI / FCRI or BHEL approved laboratory.
4. Sea Worthy packing ,if applicable

| | | | | | | | |
|----------------|--|---|---|-------------------------------------|--|--|--|
| LEGEND: | | * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | IR - Inspection Reports TC - Test Certificates AP - Approved Drawings/doc | DS - Data Sheet SP - Tech. Spec. | MR- Manufacturer records MS- Manufacturer standards | * P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. | 1 - BHEL 2 - Vendor 3 - Sub-vendor |
|----------------|--|---|---|-------------------------------------|--|--|--|


175

|  STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC) | | QUALITY PLAN NO.: PE-QP-999-145-I-006 VOLUME IIB SECTION D REV. NO. 05 DATE: 24.07.2010 SHEET 1 OF 6 | | | | | | | | | | |
|---|---|--|------------|---|--|--|--|--|-----------------|-------------|---------------|---|
| 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 | |
| 1.0 MATERIAL | | | | | | | | | | | | |
| 1.1 | Body & Bonnet casting / forgings, plug, stem. | 1. Physical, Chemical properties 2. Heat Treatment 3. Internal quality of castings | MA | Physical, Chemical tests Review of H.T. Chart RT for Body & UT for Bonnet (NDT) | One/Heat (HT Batch) Each H.T. 100% | Approved drg. / data sheet / BHEL specn. Approved drg. / data sheet / BHEL specn. ASME B 16.34 | Approved drg. / data sheet / BHEL specn. Approved drg. / data sheet / BHEL specn. ASME B 16.34 | Test Certificate Test Certificate Test Report / FILM | 3 3/2 3/2 | — 2 2 | 2,1 1 1 | IBR Certification (if applicable) to be verified by BHEL Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification. |
| | | 4. Surface Quality | MA | 1. Visual 2. MT/PT | 100% 100% | MSS-SP-55 ASME B 16.34 | MSS-SP-55 ASME B 16.34 | Test Certificate Test Certificate | 3/2 3 | — 2 | 2,1 1 | After Machining on machined surface only |
| | | 5. Pressure test for shell | MA | Hyd. Test | 100% | ISA-S-75.19/ ASME B 16.34 | ISA-S-75.19/ ASME B 16.34 | Test Certificate | 2 | 2 | 1 | For Body & Bonnet after machining |

| | | | | | | | |
|--|--|--|--|--|---|--|--|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | | | | RT - Radiographic Test UT - Ultrasonic Test | PT - Dye penetrant Test MT - Magnetic Test | P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. | 1 - BHEL 2 - Vendor 3 - Sub-vendor |
|--|--|--|--|--|---|--|--|

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC) | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-I 006 VOLUME IIB SECTION D REV. NO. 05 SHEET 2 OF 6 DATE: 24.07.2010 | | | |
|---|--|--|------------|--|--|--|--|--|-------------------|----------------|-------------------|---|--|--|--|
| 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 | | | | |
| 1.2 | Diaphragm | 1. Surface Quality 2. Hardness 3. Endurance / Life cycle | MA | Visual Measurement Cyclic test 10,000 cycles | 100% 100% One / Type | Mfr. standard Mfr. standard 10,000 cycles / Mfr. standard. | Mfr. standard Mfr. standard No damage | Test Certificate Test Certificate Test Certificate | 3/2 3/2 3/2 | -- -- -- | 2,1 2,1 2,1 | | | | |
| 1.3 | Spring | 1. Composition 2. Mech. Properties 3. Performance | MA | Chemical-Analysis Mech. Test 1. Stiffness ratio 2. Scragging | One sample / Heat One sample / Heat 100% 100% | Material spec. / Mfr. standard Material spec. / Mfr. standard Material spec. / Mfr. standard | Material spec. / Mfr. standard Material spec. / Mfr. standard Material spec. / Mfr. standard | Test Certificate Test Certificate Test Certificate | 3 3 3 | -- -- -- | 2,1 2,1 2,1 | | | | |
| 1.4 | Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)] | 1. Routine Test 2. Degree of protection | MA | 3. Cyclic test (Endurance) 4. Dimension (Measurement) HV, IR, Continuity function IP/NEMA Tests | One / type One sample / Lot 100% | 10,000 cycles Mfr. standard Rele. Standards | Material spec. / Mfr. standard Appd Drg Rele. Standards | Test Certificate Record Test Certificate | 3 3 3 | -- -- -- | 2,1 2,1 2,1 | In case TC is not available, Actual test shall be conducted | | | |

177

|  PEM :: C&I | | STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC) | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-I 006 VOLUME IIB SECTION D REV. NO. 05 SHEET 3 OF 6 DATE: 24.07.2010 | | | |
|---|--|---|------------|------------------------------------|-------------------------------|----------------------------|----------------------------|-------------------|-----------|---|-----|---|--|--|--|
| 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 | | | | |
| 1.5 | Pressure Gauges | 1. Performance | MA | Review of calibration certificates | 100% | Mfr. Standard | Mfr. Standard | Test Certificate | 3 | — | 2,1 | | | | |
| | | 2. Marking | MA | Visual | 100% | Mfr. standard | Mfr. standard | Records | 3 | — | 2,1 | | | | |
| 2.0 | IN PROCESS INSPECTION | | | | | | | | | | | | | | |
| 2.1 | Body & Bonnet after machining, Plug with actuator stem | 1. Surface flaws | MA | Visual & MT/PT | 100% (on accessible surfaces) | ASME B 16.34 | ASME B 16.34 | Test Records | 2 | — | 1 | Butt weld ends shall be included. | | | |
| | | 2. Dimensional checks | MA | Measurement | 100% | Mfr. Standard | Mfr. Standard | Records | 2 | — | 1 | | | | |
| | | 3. Hard facing (wherever applicable) | MA | Hardness Measurement | One sample/Lot | Mfr. Standard | Mfr. Standard | Records | 2 | — | 1 | | | | |
| 2.2 | Lapping | Machining surface contact | MA | Blue Matching | One sample/lot | ----- | Proper Physical Contact | Test Records | 2 | | | | | | |
| 3.0 | TESTS ON COMPLETED VALVE | | | | | | | | | | | | | | |
| 3.1 | Actuator Chamber | Leakage & Strength | MA | Pneumatic test | 100% | Mfr. Standard | No Leakage | Test Certificate | 2 | 1 | 1 | Refer Note-4 | | | |
| 3.2 | Body | Leakage and Pressure test (Body Mount Leakage) | MA | Hydro test | 100% | ISA - S-75.19 | No Leakage | Test Certificate | 2 | 1 | 1 | Refer Note-4 | | | |
| 3.3 | Seat leakage test for completed valve | Seat Leakage | MA | Pneumatic Test | 100% | FCI-70.2 | FCI-70.2 | Test Certificate | 2 | 1 | 1 | Refer Note-4 | | | |
| 4.0 | OPERATION TEST ON COMPLETED VALVE (Final inspection) | 1. Valve Travel | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | | | |
| | | 2. Opening/Closing time | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | | | |


| | | | | |
|---|--|---|---|--|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | RT - Radiographic Test UT - Ultrasonic Test | PT - Dye penetrant Test MT - Magnetic Test | \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. | 1 - BHEL 2 - Vendor 3 - Sub-vendor |
|---|--|---|---|--|

178

77

| STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC) | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-I 006 | | | |
|---|--|-------------------------|------------|---|-----------------|--|--|-------------------|----------|---------------------------------------|---|---|--|
| | | | | | | | | | | VOLUME IIB | | | |
| | | | | | | | | | | SECTION D | | | |
| | | | | | | | | | | REV. NO. 05 | | DATE: 24.07.2010 | |
| | | | | | | | | | | SHEET 4 | | OF 6 | |
| 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 | | |
| 3. | Linearity/cam characteristic | | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | |
| 4. | Repeatability | | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | |
| 5. | Hysteresis | | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | |
| 6. | Sensitivity | | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | |
| 7. | Accuracy (Overall) | | MA | Measurement | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 | |
| 8. | Control Valve characteristics / CV Test | | MA | ♦ Measurement (Press. vs. discharge vs. opening 0-100% in steps of 10%) | One per type | As per specs/ Approved drg. / data sheet | As per specs/ Approved drg. / data sheet | Test Certificate | 2 | - | 1 | ♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1. | |
| 9. | Operation of limit switch & solenoids and other accessories | | MA | Function | 100% | Approved drg. / data sheet | As per specs/ Approved drg. / data sheet | Test Report | 2 | 1 | 1 | On assembled valve Refer Note-4 | |
| 10. | Overall dimensions | | MI | Visual and dimensional | 100% | Approved drg. / data sheet | As per specs/ Approved drg. / data sheet | Records | 2 | 1 | 1 | Refer Note-4 | |
| 11. | Pre defined valve position in case of air failure | | MA | Visual | 100% | As per spec & Appd drg | As per spec & Appd drg | Test Certificate | 2 | 1 | 1 | | |
| 12. | Cleanliness, painting, stamping (for direction of flow), Tag No. | | MA | Visual and dimensional | 100% | Approved drg. / data sheet | As per specs/ Approved drg. / data sheet | Test Certificate | 2 | 1 | 1 | | |

| | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|---|--|--|--|---|--|--|--|--|--|--|--|
| LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics | | | | RT - Radiographic Test UT - Ultrasonic Test | | | | PT - Dye penetrant Test MT - Magnetic Test | | | | \$ 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 CONTROL VALVE (PNEUMATIC) | | QUALITY PLAN NO.: PE-QP-999-145-1006 | | | | | | | | | | |
|---|-----------------------|--------------------------------------|------------|----------------------|-----------------|---------------------|------------------|-------------------|----------|---|---|---------|
| | | VOLUME IIB | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | |
| | | REV. NO. 05 | | | | | DATE: 24.07.2010 | | | | | |
| | | SHEET 5 | | | | | OF 6 | | | | | |
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency's | | | Remarks |
| | | | | | | | | | P | W | V | |

| 5.0 AUXILIARY ITEMS | | | | | | | | | | | | |
|---------------------|--|--|----|--|-----------|--|--|-------------------|-----|----|-----|----------------------------------|
| 5.1 | Positioner | Overall leakage after assembly including Nozzles leakage | MA | Leak Test (in the steady state input signal) | 100 % | Mfr. Standard | No leakage | Test Certificate | 3/2 | -- | 1 | Overall leakage including tubing |
| 5.2 | Air filter regulator | 1. Normal air consumption | MA | Measurement | Each type | Mfr. Standard | No leakage | Test Certificate | 3/2 | -- | 1 | |
| | | 2. Overall leakage | MA | Visual (soap solution) | 100 % | Mfr. Standard | No leakage | Test Certificate | 3/2 | -- | 1 | |
| 5.3 | Air lock relay | Performance Test | MA | Leakage test | 100% | Mfr. Standard | No leakage | Test Certificate | 3/2 | -- | 1 | |
| 5.4 | Electronic position transmitter(not applicable if provided integral to smart positioner) | 1. Accuracy | MA | Operation | 100% | Approved data sheet / | Approved data sheet / | Test Certificate | 2 | 1 | 1 | On completed valve |
| 5.5 | Current to Pneumatic converter(not applicable for smart positioner) | 1. Physical Verification Make/Model | MA | Visual | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Certificate | 2 | -- | 2,1 | |
| | | 2. Degree of Protection | MA | IP/NEMA test | Each type | Relevant Standard | Relevant Standard | Test Certificate | 3 | -- | 2,1 | |
| | | 3. Linearity | CR | Measurement | 100% | Approved drg. / data sheet / BHEL specn. | Approved drg. / data sheet / BHEL specn. | Inspection Report | 2 | -- | 1 | |
| | | 4. Hysteresis | CR | Measurement | 100% | Approved drg. / data sheet / BHEL specn. | Approved drg. / data sheet / BHEL specn. | Inspection Report | 2 | -- | 1 | |

| | | | | | | | | | | | | | | | | | |
|---------|--|--|----------------------------|--|--|-----------------------|--|--|-------------------------|--|--|------------------------------------|--|--|----------------|--|--|
| LEGEND: | | | | | | | | | | | | | | | | | |
| * CR | | | - Critical characteristics | | | RT- Radiographic Test | | | PT - Dye penetrant Test | | | \$ P - Agency Performing the Test. | | | 1 - BHEL | | |
| MA | | | - Major characteristics | | | UT - Ultrasonic Test | | | MT- Magnetic Test | | | W - Agency Witnessing the Test. | | | 2 - Vendor | | |
| MI | | | - Minor characteristics | | | | | | | | | V - Agency Verifying the Test. | | | 3 - Sub-vendor | | |

180

76

|  STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC) | | QUALITY PLAN NO.: PE-QP-999-145-J 1006 | | | | | | | | | |
|---|----------------------------------|---|----------------------------|---|--|--|--|--|-----------------------|---------------------------|--------------|
| | | VOLUME | SECTION | REV. NO. | SHEET | OF | 6 | | | | |
| PEM :: C&I | | IIB | | D | | DATE: 24.07.2010 | | | | | |
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency | Remarks | |
| 5.6 | Smart Positioner (As Applicable) | 1. Physical Verification Make/Model 2. Degree of Protection 3. Linearity 4. Hysteresis 5. Calibration with Hand Held Communicator | MA MA CR CR MA | Visual IP/NEMA test Measurement Measurement Measurement | 100% Each type 100% 100% Each type | Approved drg. / data sheet Relevant Standard Approved drg. / data sheet / BHEL specn. Approved drg. / data sheet / BHEL specn. Approved data sheet / Mfr. Standard | Approved drg. / data sheet Relevant Standard Approved drg. / data sheet / BHEL specn. Approved drg. / data sheet / BHEL specn. Approved data sheet / Mfr. Standard | Test Certificate Test Certificate Inspection Report Inspection Report Test Certificate | 2 3 2 2 2 | 2,1 2,1 1 1 1 | |
| 6.0 | PAINTING | Soundness of Painting | MA | Visual and Measurement | 100% | BHEL specn. / Mfr. Standard | BHEL specn. / Mfr. Standard | Inspection Report | 2 | 1 | Refer Note-2 |
| 7.0 | PACKING | Soundness of Packing against transit damage | MA | Visual | 100% | Mfr. Standard | Mfr. Standard | Inspection Report | 2 | — | Refer Note-3 |


NOTES:

1. Cv test will be conducted if Test Certificate for a similar Model / Size / Cv is not available. Validity of the certificate considered as last 3 years. Cv test conducted at IIT/FCRI/any govt. approved laboratory shall not be witnessed by BHEL.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing, if applicable.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's (Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests (Leak/Operation) shall be submitted to BHEL for verification and acceptance.

| | | | | | | | | |
|----------------|----|-------------------------|----------------------------|------------------------|---------------------------------|-------------|-------------------------------|----------------|
| LEGEND: | | * CR | - Critical characteristics | RT - Radiographic Test | PT - Dye penetrant Test | \$ P | - Agency Performing the Test. | 1 - BHEL |
| | MA | - Major characteristics | UT - Ultrasonic Test | MT - Magnetic Test | W - Agency Witnessing the Test. | | | 2 - Vendor |
| | MI | - Minor characteristics | | | V - Agency Verifying the Test. | | | 3 - Sub-vendor |

181

**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.

183

| | | | |
|---|--|-------------------|-------|
|  | 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

| | | | |
|---|---|-------------------|-------|
|  | <p>Technical specification for Local Control Panel</p> | 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 condition | CLOSED | AMBER | Motor TRIPPED condition |
| RED | Motor ON/Valve condition | OPEN | WHITE | Normal/healthy 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 | |
| | | | | | |
| | | | | | |
| | | | | | |

|  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 1 OF 7 | | | | | | | | | | |
|---|---------------------------|---|----------------------------------|--|--|---|--|--|----------------------------|----------------------------|----------------------------|---------|
| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency's | | | 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 |
|--|--|--|


193

| STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL | | | | | | | | | | QUALITY PLAN NO.: PE-QP-999-145-1056 | | | |
|---|---|---|------------|----------------------|-----------------|--------------------------------|--------------------------------|-------------------|-----------|--------------------------------------|---|---------|--|
| | | | | | | | | | | VOLUME | | IIB | |
| | | | | | | | | | | SECTION | | D | |
| | | | | | | | | | | REV. NO. | | 01 | |
| | | | | | | | | | | SHEET | | 3 OF 7 | |
| | | | | | | | | | | DATE: 18-05-2007 | | | |
| 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 | | |
| 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 | — | — | | |
| | | | MA | Visual | Sample | BHEL Spec. & Mfrs. Catalogue | BHEL Spec. & Mfrs. Catalogue | Log Book | 2 | — | — | | |
| | | | MA | Electrical | Sample | BHEL Spec. & Mfrs. Catalogue | BHEL Spec. & Mfrs. Catalogue | Log Book | 2 | — | — | | |
| | IN PROCESS | | | | | | | | | | | | |
| 6.0 | Blanking / Bending / Forming | 1. Dimensions 2. Surface defects after bending | MI | Measurement | 100% | Approved Mfr. drgs. | Approved Mfr. drgs. | Log Book | 2 | — | — | | |
| | | | MA | Visual | 100% | Factory Standard | Factory Standard | Log Book | 2 | — | — | | |
| 7.0 | Nibbling / Punching | 1. Cutout Sizes 2. Deburring | MI | Measurement | 100% | Approved Mfr. drgs. | Approved Mfr. drgs. | Log Book | 2 | — | — | | |
| | | | MA | Visual | 100% | 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 | Log Book | 2 | — | 2 | | |
| | | | MA | Measurement | 100% | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book | 2 | — | 2 | | |
| | | | MA | Visual | 100% | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book | 2 | — | 2 | | |
| | | | MA | Visual | 100% | 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


|  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 4 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 | |
| 9.0 | Pre-treatment and Painting | 1. Pretreatment Process | MA | Visual | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 2. Process parameters like bath temp. concentration etc. | MA | Measurement | Periodic | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 3. Dipping / Removal Time | MA | Measurement | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 4. Surface quality after every dip | MA | Visual | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 5. Primer after phosphating | MA | Visual, Thickness | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 6. Putty Application & Rubbing after primer | MA | Visual | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 7. Paint first coat | MA | Visual, Thickness | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 8. Putty Application and Rubbing after first coat of paint | MA | Visual | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 1 | |
| | | 9. Paint second coat | MA | Visual, Thickness, Scratch test Colour adhesion | 100% | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book | 2 -- 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 |
|--|--|--|--|--|

|  STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL | | QUALITY PLAN NO.: PE-QP-999-145-J056 | | | | | | | | | | |
|---|---------------------------|--|------------|----------------------|-----------------|------------------------------|------------------------------|-------------------|-----------|---|---|---------|
| | | VOLUME IIB | | | | | | | | | | |
| | | SECTION D | | | | | | | | | | |
| | | REV. NO. 01 DATE: 18-05-2007 | | | | | | | | | | |
| | | SHEET 5 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 | |
| 10. | Panel Wiring | 1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor | MA | Visual | 100% | Approved drgs. & Specs. | Approved drgs. & Specs. | Log Book | 2 | — | — | — |
| | | | MA | Visual | 100% | Approved drgs. & Specs. | Approved drgs. & Specs. | Log Book | 2 | — | — | — |
| | | | MA | Visual | 100% | Approved drgs. & Specs. | Approved drgs. & Specs. | Log Book | 2 | — | — | — |
| | | | MA | Visual | 100% | Approved drgs. & Specs. | Approved drgs. & Specs. | Log Book | 2 | — | — | 1 |
| | | | MA | Measurement | 100% | Approved drgs. & Specs. | Approved drgs. & Specs. | Log Book | 2 | — | — | 1 |
| 11. | Component Mounting | 1. Correct components 2. Fixing | MA | Visual | 100% | Approved drgs., Specs. & BOM | Approved drgs., Specs. & BOM | Log Book | 2 | — | — | — |
| | | | MA | Visual | 100% | Approved drgs., Specs. & BOM | Approved drgs., Specs. & BOM | Log Book | 2 | — | — | — |
| 12. | FINAL Final Inspection | 1. Workmanship 2. Component layout (neatness, accessibility & safety) 3. Components identification Marking / Name plates | MA | Visual | 100% | Factory Standard | Factory Standard | Inspection Report | 2 | 1 | 1 | 1 |
| | | | MA | Visual | 100% | BHEL approved drg. / Spec. | BHEL approved drg. / Spec. | Inspection Report | 2 | 1 | 1 | 1 |
| | | | MA | Visual | 100% | BHEL approved drg. / Spec. | BHEL approved drg. / Spec. | Inspection Report | 2 | 1 | 1 | 1 |

At Random by BHEL, based on 100 % internal test reports by Mfr.


| | | | | |
|-----------|-------------------------------|----|---------------------------------|----------------|
| LEGEND: * | CR - Critical characteristics | \$ | P - Agency Performing the Test. | 1 - BHEL |
| | MA - Major characteristics | W | W - Agency Witnessing the Test. | 2 - Vendor |
| | MI - Minor characteristics | V | V - Agency Verifying the Test. | 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 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 Mr. | | | |
| 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
 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


|  PEM :: C&I | | 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 ^s | | | 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


**Data sheet and Wiring Diagram
for
Motorized Valve Actuator**

| | | | | |
|---|---|---|---|----------------|
|  | SPECIFICATION FOR MOTORISED VALVE ACTUATOR | | SPECIFICATION NO.: PE-SS-999-145-1007 | |
| | | | VOLUME II B | |
| | | | SECTION D | |
| | | | REV. NO. 02 | DATE: 17.09.07 |
| | | | SHEET 1 | OF 3 |
| Data Sheet A & B | | | | |
| DATA SHEET-A (TO BE FILLED BY PURCHASER) | | | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) | |
| GENERAL* | * PROJECT | 400 MW MARIB GTPS-II | | |
| | OFFER REFERENCE | | | |
| | * TAG NO. SERVICE | | | |
| | * DUTY | <input type="checkbox"/> ON / OFF | <input type="checkbox"/> INCHING | |
| | * LINE SIZE (inlet/outlet): MATERIAL | | | |
| | * VALVE TYPE | <input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY | | |
| | * OPENING / CLOSING TIME | | | |
| | * WORKING PRESSURE | | | |
| | AMBIENT CONDITION | SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95% | | |
| | VALVE SEAT TEST PRESS | BIDDER TO SPECIFY | | |
| | REQUIRED VALVE TORQUE | BIDDER TO SPECIFY | | |
| | ACTUATOR RATED TORQUE | BIDDER TO SPECIFY | | |
| | CONSTRUCTION AND SIZING | CONSTRUCTION | TOTALLY ENCLOSED, WEATHER PROOF, IP:55 | |
| MECHANICAL POSITION INDICATOR | | TO BE PROVIDED FOR 0-100% TRAVEL | | |
| BEARINGS | | DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION. | | |
| GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION | | METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED. | | |
| SIZING | | OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM | | |
| HANDWHEEL | * REQUIRED | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | |
| | * ORIENTATION | <input type="checkbox"/> TOP MOUNTED | <input type="checkbox"/> SIDE MOUNTED | |
| | TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION. | | | |
| ELECTRIC ACTUATOR | ACTUATOR MAKE/MODEL | BIDDER TO SPECIFY | | |
| | MOTOR MAKE / MODEL / TYPE / RATING (KW) | BIDDER TO SPECIFY | | |
| | MOTOR TYPE | SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT. | | |
| | ACTUATOR APPLICABLE WIRING DIAGRAM | <input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input checked="" type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 | | |
| | COLOUR SHADE | <input type="checkbox"/> BLUE (RAL 5012) ENAMEL <input type="checkbox"/> | | |
| | SHAFT RPM | BIDDER TO SPECIFY | | |
| | OLR SET VALUE | BIDDER TO SPECIFY | | |
| | STARTING / FULL LOAD CURRENT | BIDDER TO SPECIFY | | |
| | NO. OF REV FOR FULL TRAVEL | BIDDER TO SPECIFY | | |
| | @ PWR SUPP TO MTR / STARTER | 415V, 3PH, AC | | |
| | @ CONTROL VOLTAGE REQUIREMENT | TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V | | |
| | @ ENCLOSURE CLASS OF MOTOR | <input type="checkbox"/> IP 65 <input type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF <input type="checkbox"/> IP 55, TOTALLY ENCL, SELF VENTILATED. | | |
| | @ INSULATION CLASS | <input type="checkbox"/> CLASS-B <input type="checkbox"/> CLASS-F | | |
| | @ WINDING TEMP PROTECTION | <input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> | | |

201

| | | | | |
|---|---|---|--|----------------|
|  | SPECIFICATION FOR MOTORISED VALVE ACTUATOR | | SPECIFICATION NO.: PE-SS-999-145-I007 | |
| | | | VOLUME II B | |
| | | | SECTION D | |
| | | | REV. NO. 02 | DATE: 17.09.07 |
| | | | SHEET 2 | OF 3 |
| Data Sheet A & B | | | | |
| DATA SHEET-A (TO BE FILLED BY PURCHASER) | | | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) | |
| INTEGRAL STARTER | SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION | | REQUIRED | |
| | INTEGRAL STARTER | | <input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED | |
| | TYPE OF SWITCHING DEVICE | | <input type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS | |
| | TYPE | | <input type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE) | |
| | IF SMART | | | |
| | a) SERIAL LINK INTERFACE | | <input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED | |
| | b) SERIAL LINK PROTOCOL | | <input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> TCP/IP <input type="checkbox"/> | |
| | c) SERIAL LINK MEDIA | | <input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC | |
| | d) HAND HELD PROGRAMMER | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | e) MASTER STATION | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | f) MASTER STN INTRFACE WITH DCS | | <input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP | |
| | g) DETAILS OF SPECIAL CABLE | | <input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED | |
| | STEP DOWN CONT. TRANSFORMER | | <input type="checkbox"/> REQUIRED | |
| | OPEN / CLOSE PB | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | STOP PB | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | INDICATING LAMPS | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | LOCAL REMOTE S/S | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | STATUS CONTACTS FOR MONITORING | | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| INTEGRAL STARTER DISTURBED SIGNAL | | REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY) | | |
| INTERPOSING RELAY (Applicable for integral Starter) | INTERPOSING RELAYS | | REQUIRED | |
| | INTERPOSING RELAY (QUANTITY) | | <input type="checkbox"/> 2 Nos. <input type="checkbox"/> 3 Nos. | |
| | DRIVING VOLTAGE | | <input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC | |
| | DRIVING CURRENT | | <input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX | |
| | LOAD RESISTANCE | | <input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms | |
| TORQUE SWITCH (Not Applicable for Smart Actuator) | MFR & MODEL NO. | | BIDDER TO SPECIFY | |
| | OPEN / CLOSE | | <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos | |
| | CONTACT TYPE | | 2 NO + 2 NC | |
| | RATING | | 5A 240V AC AND 0.5A 220V DC | |
| | CALIBRATED KNOBS(OPEN&CLOSE TS) | | REQUIRED FOR SETTING DESIRED TORQUE | |
| | ACCURACY | | +3% OF SET VALUE | |
| LIMIT SWITCH (Not Applicable for Smart Actuator) | MFR & MODEL NO. | | BIDDER TO SPECIFY | |
| | OPEN : INT : CLOSE | | <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2 Nos. 2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. | |
| | CONTACT TYPE | | 2 NO + 2 NC | |
| | RATING (AC / DC) | | 5A 240V AC AND 0.5A 220V DC | |

202

| | | | | |
|---|---|--|---|----------------|
|  | SPECIFICATION FOR MOTORISED VALVE ACTUATOR | | SPECIFICATION NO.: PE-SS-999-145-I007 | |
| | | | VOLUME II B | |
| | | | SECTION D | |
| | | | REV. NO. 02 | DATE: 17.09.07 |
| | | | SHEET 3 | OF 3 |
| Data Sheet A & B | | | | |
| DATA SHEET-A (TO BE FILLED BY PURCHASER) | | | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) | |

| | | | | |
|-----------------------------|--|--|--|-----------|
| POSITION TRANSMITTER | POSITION TRANSMITTER (For inching duty) | REQD FOR INCHING DUTY | | |
| | MFR & MODEL NO. | BIDDER TO SPECIFY | | |
| | TYPE | <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS | | |
| | SUPPLY | <input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> | | |
| | OUTPUT | <input checked="" type="checkbox"/> 4-20mA | | |
| | ACCURACY | $\pm 1\%$ FS | | |
| SPACE HEATER | @SPACE HEATER | REQUIRED | | |
| | @ POWER SUPPLY | | | |
| | @ RATING | | | |
| TERMINAL BOX | MOTOR TERMINAL BOX | REQUIRED | | |
| | ACTUATOR TERMINAL BOX | REQUIRED | | |
| | ENCL CLASS MTR T.B. / ACTUATOR T.B. | <input type="checkbox"/> IP 65 @ <input type="checkbox"/> <input type="checkbox"/> IP65 <input type="checkbox"/> | | |
| | @ EARTHING TERMINAL | REQUIRED | | |
| | PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT) | <input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/> | | |
| CABLE GLANDS | @ POWER CABLE GLAND | SIZE: | | |
| | @ SPACE HEATER CABLE GLAND | SIZE: | | |
| | OTHER CONTROL CABLE GLANDS-1 | <input type="checkbox"/> 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2) | | |
| | OTHER CONTROL CABLE GLANDS-2 | QUANTITY & SIZE : | | |
| WEIGHT | TOTAL WEIGHT (ACTUATOR + ACCESSORIES) | BIDDER TO SPECIFY | | Kg. |

NOTES:

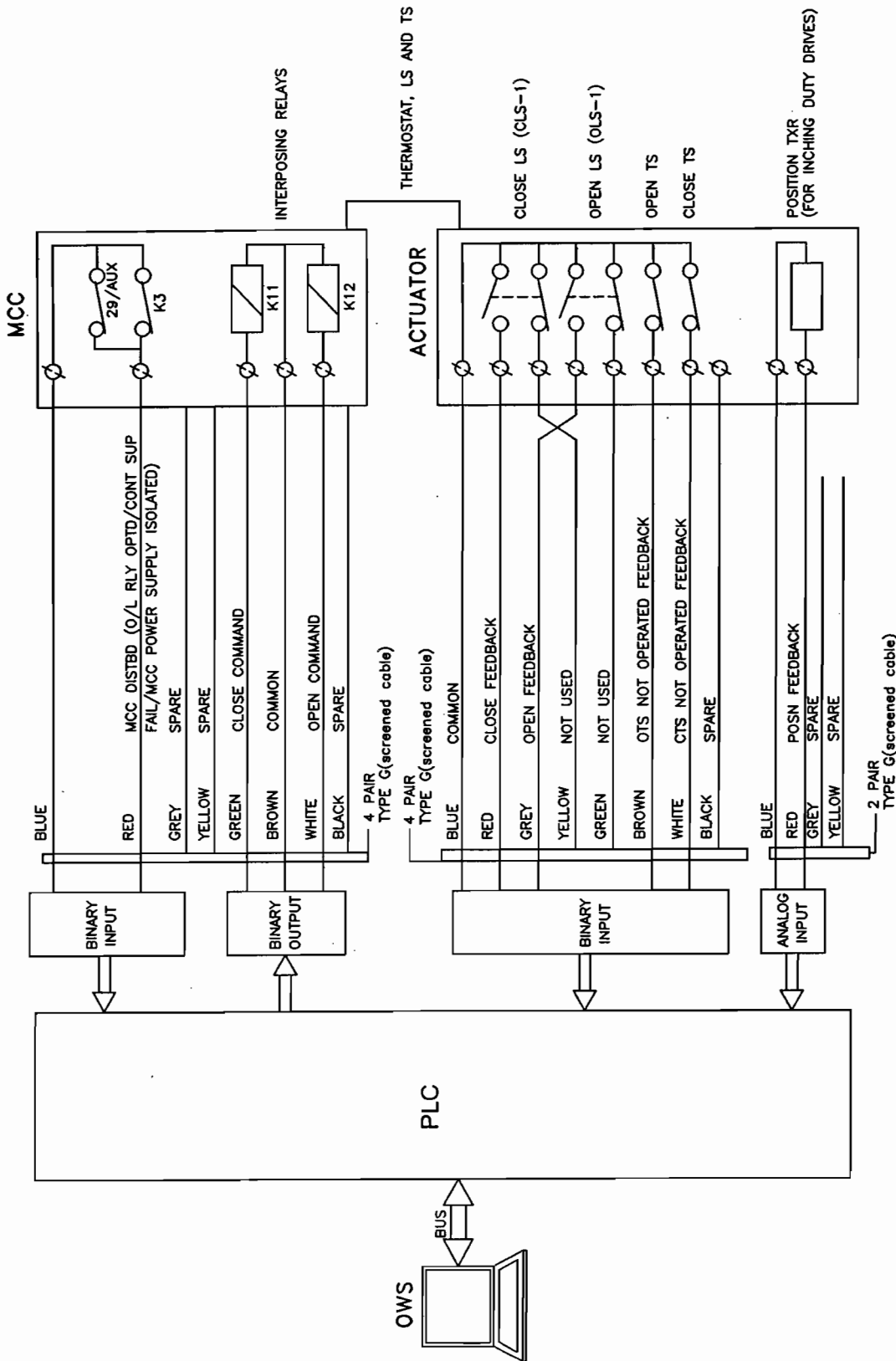
- SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE $\pm 10\%$ SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO $+3\%$ VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

| | | | | |
|---|-------------|------------|-------------|---------------------|
| NAME SIGNATURE DATE | PREPARED BY | CHECKED BY | APPROVED BY | VENDOR COMPANY SEAL |
| | | | | NAME |
| | | | | SIGNATURE |
| | | | | DATE |
| NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES | | | | |

203

64

ANNEXTURE-A PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)

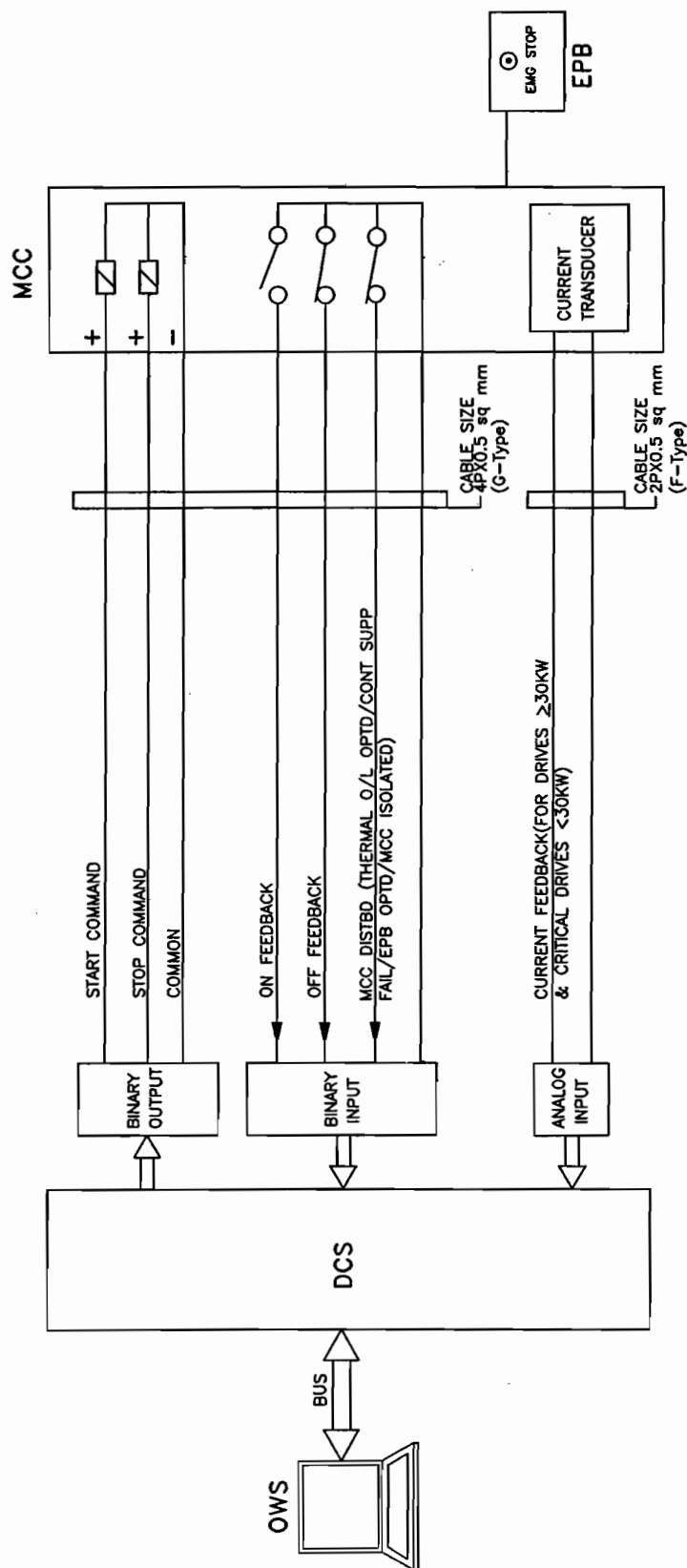


| | |
|---|---------------------------------------|
| PROJECT: 4X100 MW GTPS, MARIB-II | |
| TITLE | PLC INTERFACE FOR BIDIRECTIONAL DRIVE |



204

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE

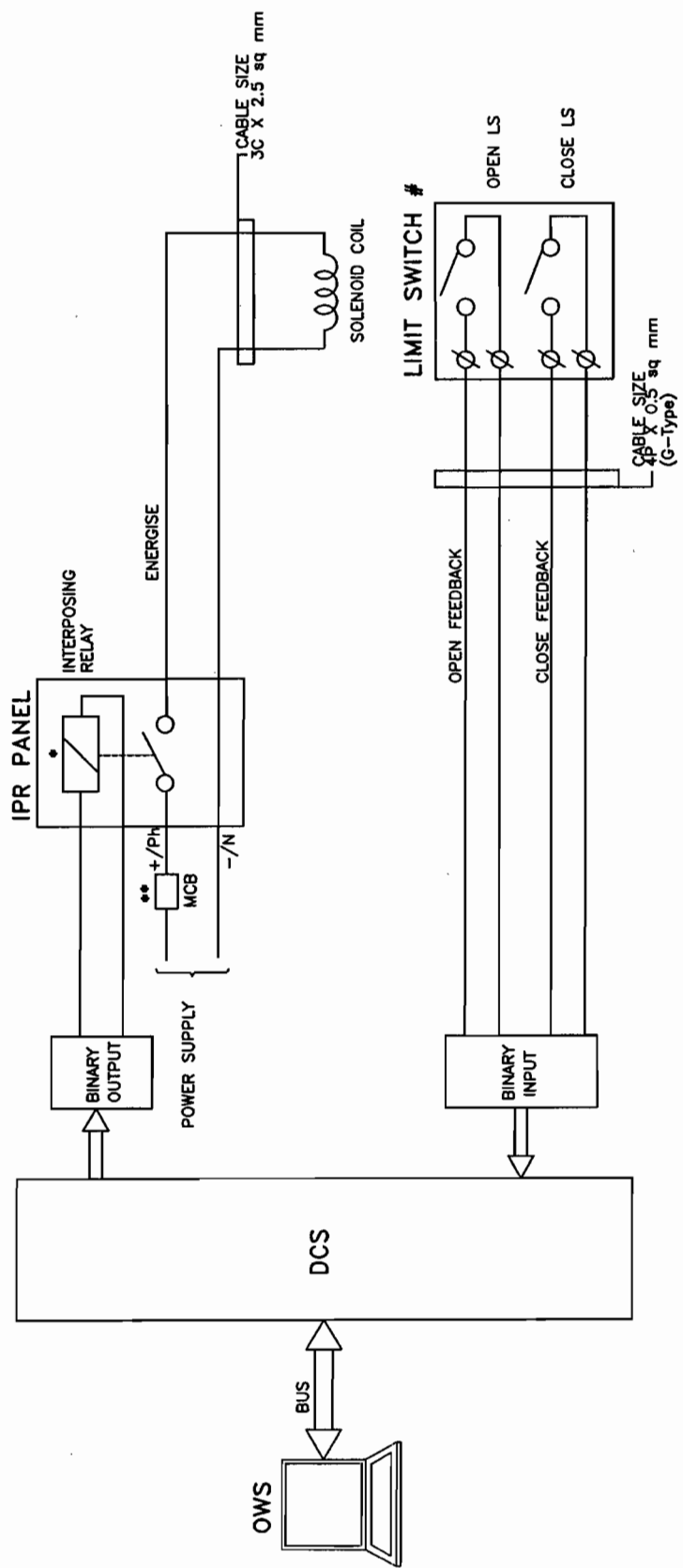


PROJECT: 4X100 MW GTPS, MARIB-II

TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE

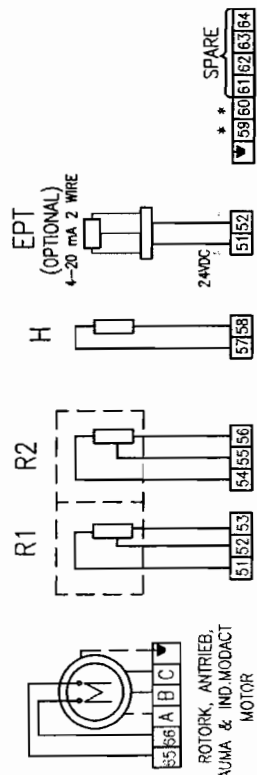
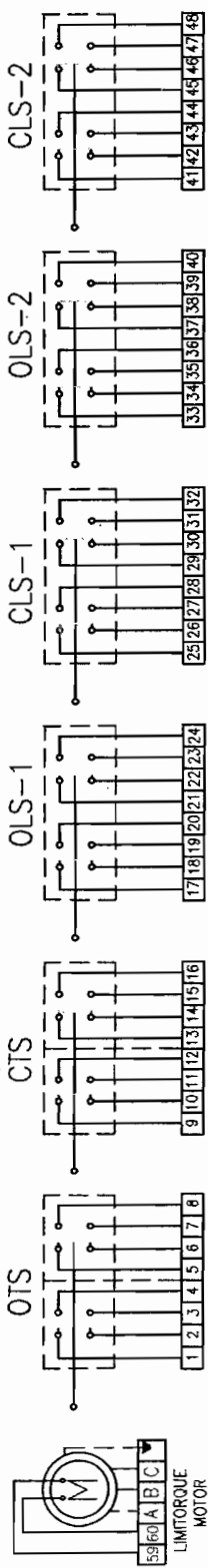
205

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



- NOTES:
- TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

| | |
|--------------|--|
| | <p>PROJECT: 4X100 MW GTPS, MARIB-II</p> |
| <p>TITLE</p> | <p>DDCMIS INTERFACE FOR SOLENOID DRIVE</p> |



* -- SPARE FOR ROTORK, AUMA, ANTRIEB & IND. MODACT
 SWITCHES -- ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY
 THERMOSTAT -- 65-66 (ROTORK), AUMA, ANTRIEB & IND. MODACT), 59-60 (LIMITORQUE).
 EPT -- ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
 THERMOSTAT TERMINALS -- TERMINATED IN MOTOR TB IN ANTRIEB & IND. MODACT AND IN MAIN TB IN OTHER MAKES
 CTS -- TORQUE SWITCHES FOR CW ROTATION (CLOSE) -- 2 NO+2 NC
 OTS -- TORQUE SWITCHES FOR CCW ROTATION (OPEN) -- 2 NO+2 NC
 OLS-1, OLS-2 -- LIMITSWITCHES FOR POSITION OPEN -- 2 NO+2 NC
 OLS-1, OLS-2 -- LIMITSWITCHES FOR POSITION CLOSE -- 2 NO+2 NC
 OTS, CTS -- TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE
 OLS-2 & CLS-2 -- CAN DISC IN ROTORK & ANTRIEB
 R1-R2 -- POTENTIOMETER 2 x 100 OHMS
 H -- SPACE HEATER 10 240V AC SUPPLY
 M -- MOTOR 30 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

| VALVES | OPEN | | CLOSE | |
|---|------|---------|-------|---------|
| | MAIN | BACK UP | MAIN | BACK UP |
| GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS | CLS | OTS | CLS | CTS |
| ALL OTHER GATE & GLOBE VALVES | CLS | OTS | CTS | Φ |

Φ - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
 NOTE:
 1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
 2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

| OTS | CTS | OLS-1 | CLS-1 | OLS-2 | CLS-2 |
|--------|--------|--------|--------|--------|--------|
| 1-2 | 1-2 | 1-2 | 1-2 | 1-2 | 1-2 |
| 3-4 | 3-4 | 3-4 | 3-4 | 3-4 | 3-4 |
| 5-6 | 5-6 | 5-6 | 5-6 | 5-6 | 5-6 |
| 7-8 | 7-8 | 7-8 | 7-8 | 7-8 | 7-8 |
| 9-10 | 9-10 | 9-10 | 9-10 | 9-10 | 9-10 |
| 11-12 | 11-12 | 11-12 | 11-12 | 11-12 | 11-12 |
| 13-14 | 13-14 | 13-14 | 13-14 | 13-14 | 13-14 |
| 15-16 | 15-16 | 15-16 | 15-16 | 15-16 | 15-16 |
| 17-18 | 17-18 | 17-18 | 17-18 | 17-18 | 17-18 |
| 19-20 | 19-20 | 19-20 | 19-20 | 19-20 | 19-20 |
| 21-22 | 21-22 | 21-22 | 21-22 | 21-22 | 21-22 |
| 23-24 | 23-24 | 23-24 | 23-24 | 23-24 | 23-24 |
| 25-26 | 25-26 | 25-26 | 25-26 | 25-26 | 25-26 |
| 27-28 | 27-28 | 27-28 | 27-28 | 27-28 | 27-28 |
| 29-30 | 29-30 | 29-30 | 29-30 | 29-30 | 29-30 |
| 31-32 | 31-32 | 31-32 | 31-32 | 31-32 | 31-32 |
| 33-34 | 33-34 | 33-34 | 33-34 | 33-34 | 33-34 |
| 35-36 | 35-36 | 35-36 | 35-36 | 35-36 | 35-36 |
| 37-38 | 37-38 | 37-38 | 37-38 | 37-38 | 37-38 |
| 39-40 | 39-40 | 39-40 | 39-40 | 39-40 | 39-40 |
| 41-42 | 41-42 | 41-42 | 41-42 | 41-42 | 41-42 |
| 43-44 | 43-44 | 43-44 | 43-44 | 43-44 | 43-44 |
| 45-46 | 45-46 | 45-46 | 45-46 | 45-46 | 45-46 |
| 47-48 | 47-48 | 47-48 | 47-48 | 47-48 | 47-48 |
| 49-50 | 49-50 | 49-50 | 49-50 | 49-50 | 49-50 |
| 51-52 | 51-52 | 51-52 | 51-52 | 51-52 | 51-52 |
| 53-54 | 53-54 | 53-54 | 53-54 | 53-54 | 53-54 |
| 55-56 | 55-56 | 55-56 | 55-56 | 55-56 | 55-56 |
| 57-58 | 57-58 | 57-58 | 57-58 | 57-58 | 57-58 |
| 59-60 | 59-60 | 59-60 | 59-60 | 59-60 | 59-60 |
| 61-62 | 61-62 | 61-62 | 61-62 | 61-62 | 61-62 |
| 63-64 | 63-64 | 63-64 | 63-64 | 63-64 | 63-64 |
| 65-66 | 65-66 | 65-66 | 65-66 | 65-66 | 65-66 |
| 67-68 | 67-68 | 67-68 | 67-68 | 67-68 | 67-68 |
| 69-70 | 69-70 | 69-70 | 69-70 | 69-70 | 69-70 |
| 71-72 | 71-72 | 71-72 | 71-72 | 71-72 | 71-72 |
| 73-74 | 73-74 | 73-74 | 73-74 | 73-74 | 73-74 |
| 75-76 | 75-76 | 75-76 | 75-76 | 75-76 | 75-76 |
| 77-78 | 77-78 | 77-78 | 77-78 | 77-78 | 77-78 |
| 79-80 | 79-80 | 79-80 | 79-80 | 79-80 | 79-80 |
| 81-82 | 81-82 | 81-82 | 81-82 | 81-82 | 81-82 |
| 83-84 | 83-84 | 83-84 | 83-84 | 83-84 | 83-84 |
| 85-86 | 85-86 | 85-86 | 85-86 | 85-86 | 85-86 |
| 87-88 | 87-88 | 87-88 | 87-88 | 87-88 | 87-88 |
| 89-90 | 89-90 | 89-90 | 89-90 | 89-90 | 89-90 |
| 91-92 | 91-92 | 91-92 | 91-92 | 91-92 | 91-92 |
| 93-94 | 93-94 | 93-94 | 93-94 | 93-94 | 93-94 |
| 95-96 | 95-96 | 95-96 | 95-96 | 95-96 | 95-96 |
| 97-98 | 97-98 | 97-98 | 97-98 | 97-98 | 97-98 |
| 99-100 | 99-100 | 99-100 | 99-100 | 99-100 | 99-100 |

BHARAT HEAVY ELECTRICALS LTD.
 UNIT: HIGH PRESSURE BOILER PLANT
 TIRUCHIRAPPALLI 620014.

INTERNAL WIRING DIAGRAM
 FOR
 ELECTRICAL VALVE ACTUATORS (AC)
 (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

365-139

NP ESWAR

KARUNACHALAM

P. LOGANATHAN

09.09.2000

09.09.2000

11

DATE

CHD

APPD

DESCRIPTION

DRAWING No.


4-V-MISC-90271

REV

11

RETRACTED WITH REVISION 11

207

| | |
|---|---|
|  | DOCUMENT TITLE |
| | <p align="center">KKS NUMBERING PHILOSOPHY</p> |
| <p align="center">4X100MW GTPS, MARIB PHASE-II</p> | |

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| X | X | X | A | A | Y | Y | B | B | B |
|---|---|---|---|---|---|---|---|---|---|

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

4X100MW GTPS, MARIB PHASE-II

ANNEXURE-1**List of System / Sub-System Codes used in Power Plant:**

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV

ANNEXURE-2**Standard Equipment Codes:**

| | |
|----|---|
| AA | Valves including drives, also hand operated |
| AB | Seclusions, Lock, Gates, Doors |
| AC | Heat Exchanger |
| AE | Turning, Driving, Lifting equipment |
| AF | Continuous conveyors, Feeders |
| AG | Generator Units |
| AH | Heating and Cooling Units |
| AK | Pressing and Packaging equipment |
| AM | Mixer, Stirrer |
| AN | Blower, Air Pumps / Fans, Compressor Units |
| AP | Pump Units |
| AT | Purification, Drying, Filter |
| AV | Combustion Equipment e.g. grates |

Standard Apparatus Codes:

| | |
|----|--|
| BB | Vessels and Tank |
| BF | Foundation |
| BG | Boiler Heating Surfaces |
| BN | Injector, Ejector |
| BP | Flow and throughput limitation equipment (Orifice) |
| BQ | Holders, Carrying Equipment, Support |
| BR | Piping, Ducts, Chutes, Compensator |
| BS | Sound Absorber |
| BU | Insulations, Sheatings |

209



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

4X100MW GTPS, MARIB PHASE-II

Standard Measuring Circuits Codes:

| | |
|----|----------------------------|
| CD | Density |
| CE | Electrical Quantities |
| CF | Flow, throughput |
| CG | Distance, Length, Position |
| CK | Time |
| CL | Level |
| CM | Humidity |
| CQ | Analysis (SWAS) |
| CS | Speed, Velocity, Frequency |
| CT | Temperature |
| CY | Vibration, Expansion |

ANNEXURE-3**Numerical Keys****A) Numerical Keys at System Code Level**

- i) Use 10, 20, 30, To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say -10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- Equipment Code – AA

N1

N2 N3

210



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

4X100MW GTPS, MARIB PHASE-II

| | | | |
|---|---|---|----------|
| Motorised (<i>on/off duty</i>) | - | 0 | 01 to 50 |
| Motorised (<i>inching duty</i>) | - | 0 | 51 to 99 |
| Pneumatic (Control) | - | 1 | 01 to 50 |
| Motorised (<i>thyristor Control</i>) | - | 1 | 51 to 99 |
| Sol. Operated | - | 2 | 01 to 99 |
| (Open / Close duty (Valves, NRVs, Gate) | | | |
| Hydraulic | - | 3 | 01 to 99 |
| NRV (Without actuation) | - | 4 | 01 to 99 |
| Manual | - | 5 | 01 to 99 |
| Manual | - | 6 | 01 to 99 |
| Relief & Safety Valves | - | 7 | 01 to 99 |
| Reserve | - | 8 | 01 to 99 |
| Reserve | - | 9 | 01 to 99 |
| ii) Field Instruments | | | |
| Field Transmitters & Analog Signals | - | 0 | 01 to 99 |
| Field Switches & Binary Signals | - | 1 | 00 to 99 |
| PG Test Point | - | 4 | 00 to 99 |
| Gauges | - | 5 | 00 to 99 |
| Automatic Turbine Tester (ATT)-HWR | - | 2 | 00 to 99 |
| (Reserved for protection Signals used by Hardwar) | | | |

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.



PEM-6666-0



| |
|------------------------------|
| TITLE |
| COMPRESSED AIR SYSTEM |
| MARIB GTPS 400 MW |

| | |
|--------------------------------------|-----------------|
| SPECIFICATION NO. PE-TS-372-555-A001 | |
| VOLUME | |
| SECTION | |
| REV 00 | DATE 20/07/2012 |
| SHEET | |

SECTION-C5

PAINTING SPECIFICATION

212

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. |
| | | | | 1 |

(PEC TENDER NO.: 12/2008)

VOLUME IV
SECTION 7.6
CLEANING, PROTECTIVE COATING AND PAINTING

FORM T9-P REV.B

213

59

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. |
| | | | | 2 |

(PEC TENDER NO.: 12/2008)

Table of Contents

| | | |
|--------|---|----|
| 7.6.0 | CLEANING, PROTECTIVE COATING AND PAINTING | 3 |
| 7.6.1 | GENERAL | 3 |
| 7.6.2 | MECHANICAL CLEANING AT MANUFACTURER'S WORKS | 4 |
| 7.6.3 | ALTERNATIVE CHEMICAL CLEANING AT MANUFACTURER'S WORKS | 5 |
| 7.6.4 | PROTECTION AT MANUFACTURER'S WORKS | 5 |
| 7.6.5 | WEATHER CONDITIONS | 5 |
| 7.6.6 | SURFACE PREPARATION | 5 |
| 7.6.7 | RUB DOWN AND TOUCH UP OF PRIMER | 8 |
| 7.6.8 | NON COMPATIBLE SHOP COAT PRIMER | 8 |
| 7.6.9 | PAINT MATERIALS | 9 |
| 7.6.10 | STORAGE | 9 |
| 7.6.11 | PREPARATION OF COATING MATERIALS | 9 |
| 7.6.12 | APPLICATION | 10 |
| 7.6.13 | SAFETY REQUIREMENTS | 10 |
| 7.6.14 | DRY FILM THICKNESS (DFT) | 10 |
| 7.6.15 | PROTECTIVE COATINGS AND PAINT SYSTEMS | 11 |
| 7.6.16 | COLOUR CODE FOR PIPING | 11 |
| 7.6.17 | IDENTIFICATION OF VESSELS, PIPING ETC. | 12 |
| 7.6.18 | INSPECTION AND TESTING | 12 |
| 7.6.19 | PRIMER APPLICATION | 13 |
| 7.6.20 | GUARANTEE | 13 |
| 7.6.21 | SCOPE OF AREAS TO BE PAINTED AND PAINTING SYSTEMS | 13 |
| 7.6.22 | GALVANIZING | 13 |
| 7.6.23 | SPRAYED METAL COATINGS | 15 |
| 7.6.24 | SAFETY OF WORK | 15 |

FORMT9-P REV-B

214

| 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.

215



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. |
| | | | | 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:

- Proper storage to avoid exposure as well as extremes of temperature.
- Surface preparation prior to painting.
- Mixing and thinning
- Application of paints and the recommended limit on time intervals between coats.
- 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:

216

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-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

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. |
| | | | | 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 atmosphere 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.

220

| 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 of Phase-I.

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.

54

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. 12 |

Colour Bands

The width of colour band shall conform to the requirements of Phase-I

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:

- Surface preparation
- Primer application
- 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.

224

FORMTSP-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-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.

226

| 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,

FICHTNER

Volume - IV

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

ANNEX - 1

PAINT SYSTEM - COASTAL AND MARINE ENVIRONMENT

| SL. NO. | SURFACE/LOCATION | TEMP. °C | SURFACE PREPARATION | COAT | PAINT SYSTEM NO. OF COATS | GENERIC TYPE | PER COAT MICRONS Dft | APPLICATION 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 | |

FICHTNER

Volume - IV

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

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

FICHTNER

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

Volume - IV

| SL. NO. | SURFACE/LOCATION | TEMP. °C | SURFACE PREPARATION | COAT | PAINT SYSTEM NO. OF COATS | GENERIC TYPE | PER COAT MICRONS Dft | APPLICATION IN SHOP | APPLICATION 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 | x | |
| | | | | | | | 50 | 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 | x | |
| | | | | Finish | 3 | F7 | 30 | x | |
| | | | | | | | 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 | | x x x |
| | | | | | | Total min. dft | 500 | | |

FICHTNER

Volume - IV

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

| SL. NO. | SURFACE/LOCATION | TEMP. °C | SURFACE PREPARATION | COAT | PAINT SYSTEM NO. OF COATS | GENERIC TYPE | PER COAT MICRONS Dft | APPLICATION IN SHOP | APPLICATION ON SITE |
|---------|---|-----------|---------------------|--------|---------------------------|----------------|----------------------|---------------------|---------------------|
| 10 | Water pipelines - outside surface, indoor | upto 60°C | Sa 3 | Prime | 2 | P2 | 50 | x | |
| | | | | Finish | 3 | F3 | 50 | x | |
| | | | | | | Total min. dft | 30 | | x |
| | | | | | | | 30 | | x |
| | | | | | | | 30 | | x |
| | | | | | | | 190 | | |
| 11 | Oil pipelines - outside surface, above ground | upto 90°C | Sa 3 | Prime | 2 | P3 | 50 | x | |
| | | | | Finish | 2 | F6 | 50 | x | |
| | | | | | | | 100 | | x |
| | | | | | | | 100 | | x |
| | | | | | | Total min. dft | 300 | | |

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



PEM-6666-0



TITLE

**COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

SECTION-C6

SEAWORTHY PACKING SPECIFICATION

232


VOLUME IIB

**TECHNICAL SPECIFICATION
FOR
SEAWORTHY PACKING FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001



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

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 1 | OF 52 |

1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 SCOPE

For export jobs, sea worthy packing 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, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.


3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 2 | OF 52 |

The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-


Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 3 | OF 52 |

7.0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.


The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 4 | OF 52 |

7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in RED colour.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:

Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top In gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

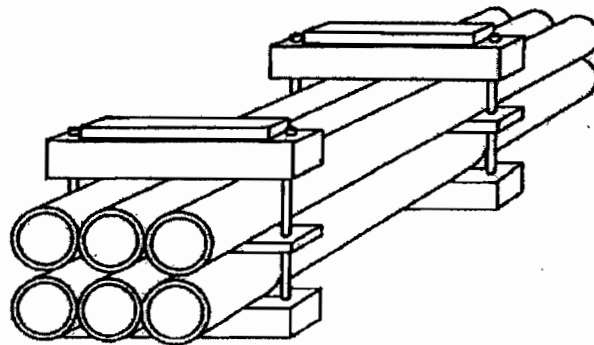
All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

237

Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2.1 Type of Equipment

Packing category I


Technical drawing illustrating the assembly of a composite structure, likely a bridge deck or floor slab, showing the arrangement of layers and reinforcement.

The drawing shows a perspective view of a rectangular structure composed of multiple layers. The top layer is labeled "upper transverse layer". Below it is the "intermediate layer". The structure is reinforced with longitudinal bars, with dimensions indicating "approx. 1 m" spacing between bars and "approx. each 2 m" for the intermediate layer.

Labels and dimensions include:

- upper transverse layer
- intermediate layer
- approx. 1 m
- approx. each 2 m
- approx. 1 m
- ensure the screwing
- [structure]
- marking 2 x alongside
- intermediate layers

238

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 6 | OF 52 |

- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

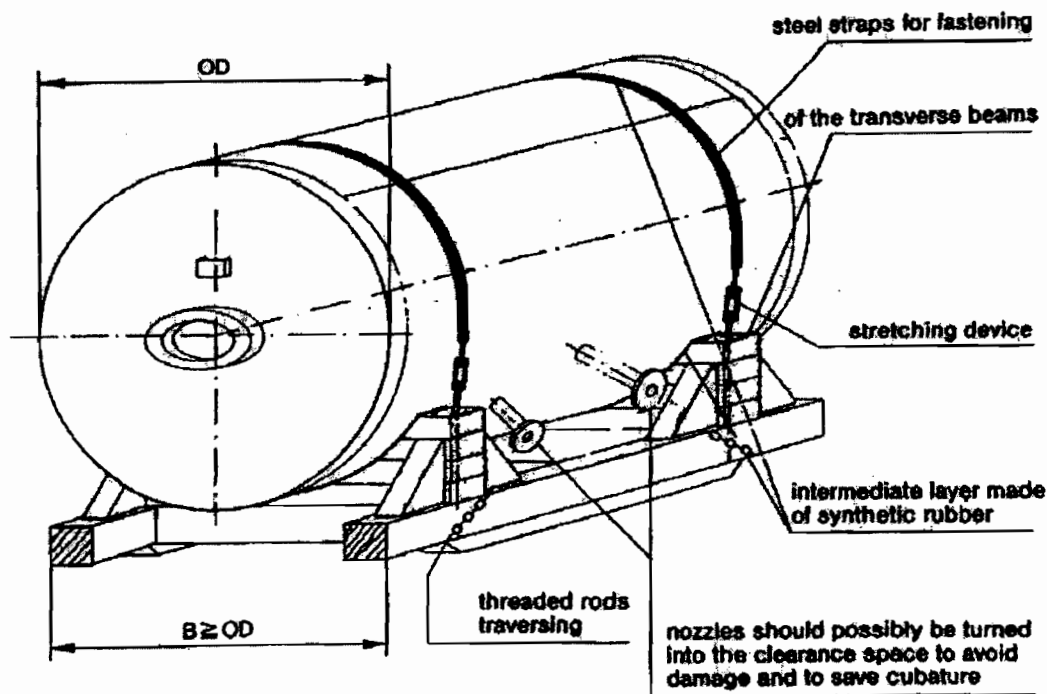
8.3.1 Type of Equipment


Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



| | | | |
|---|---|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 7 | OF 52 |

8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

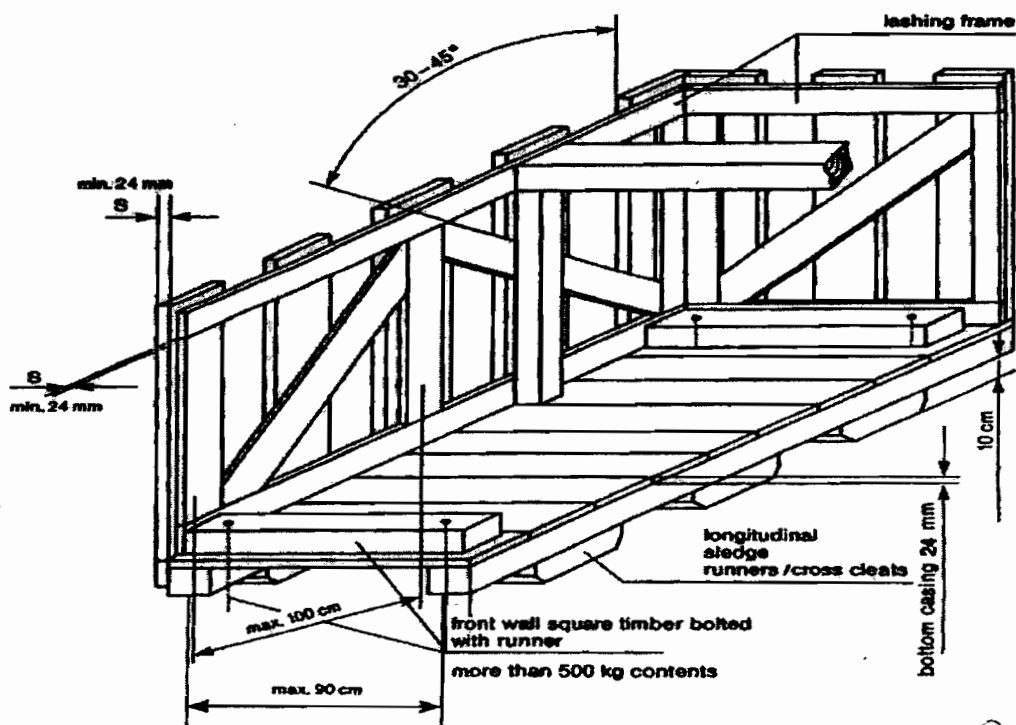
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings; mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



240

| | | | |
|--|--|--------------------------------------|-----------------|
| | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 8 | OF 52 |

8.4.2 Cases with Lining – Packing Category IV

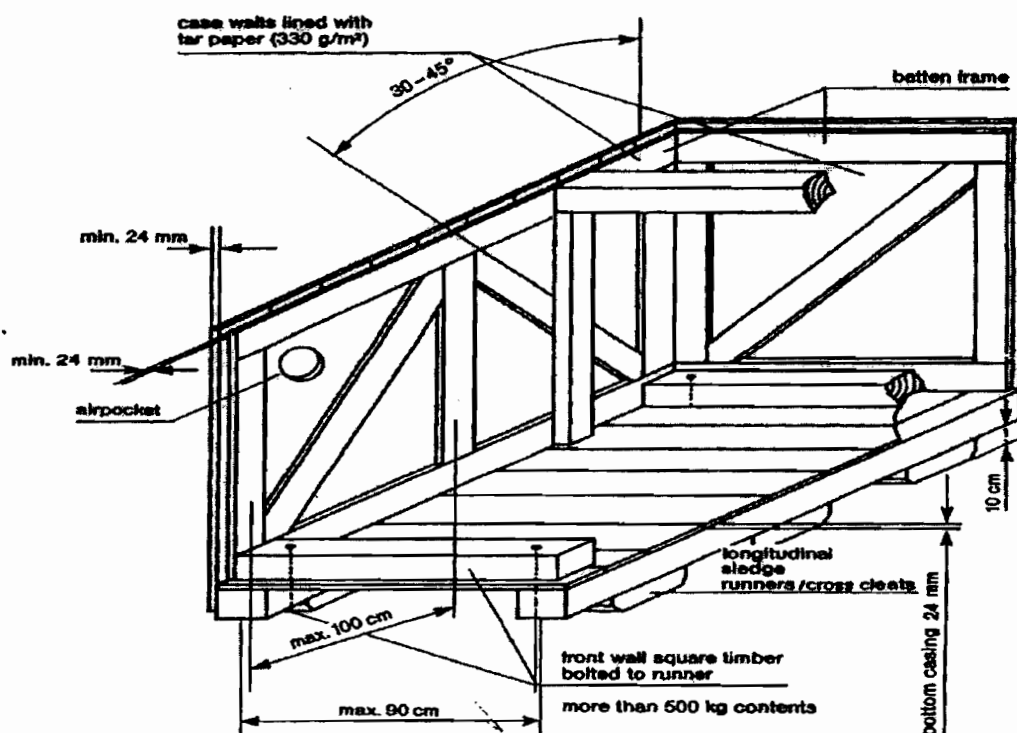
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

Packing Category IV

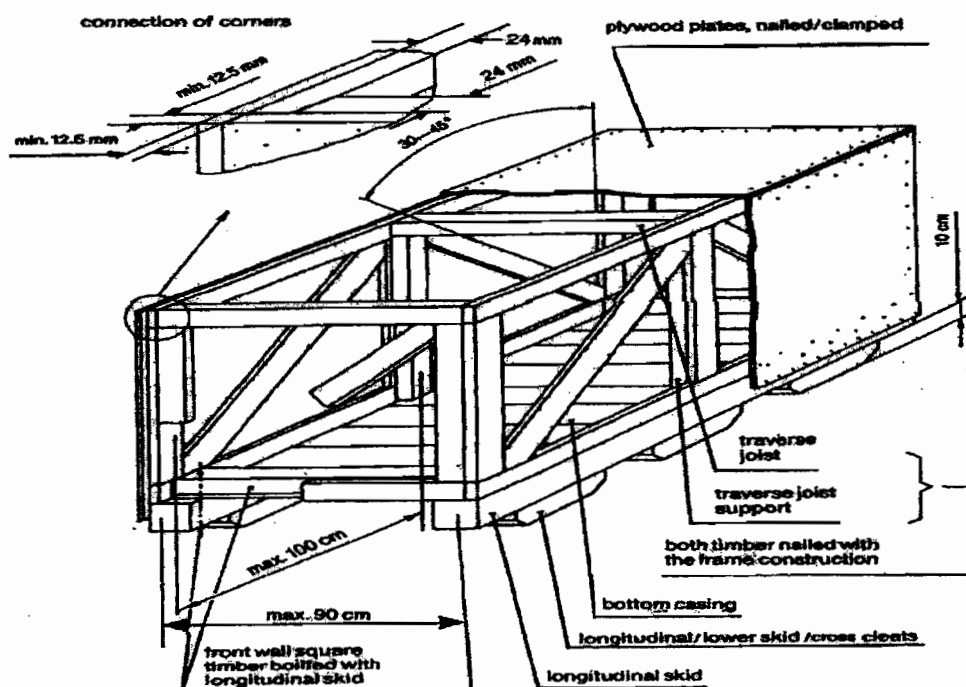


8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

241

| | | | |
|--|--|--------------------------------------|-----------------|
| | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 9 | OF 52 |



Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction


Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

• Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 10 | OF 52 |

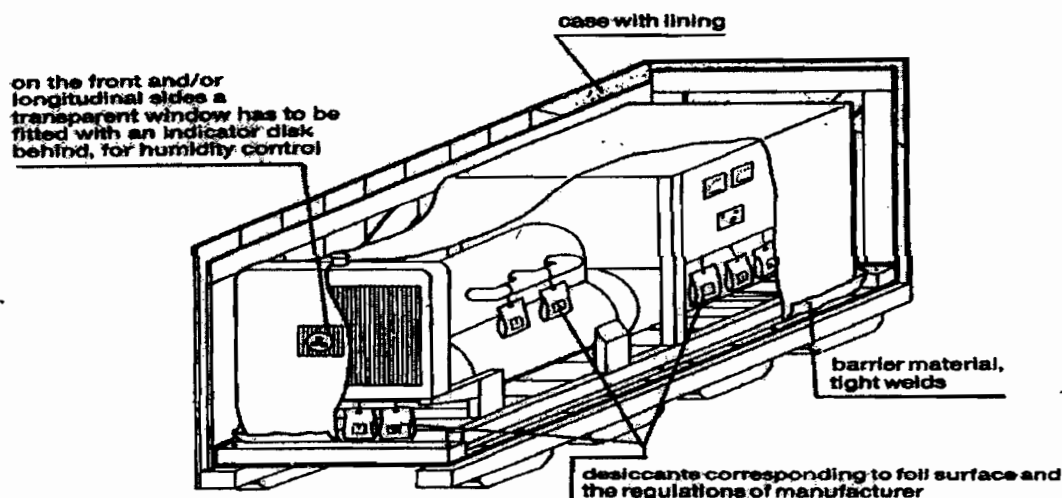
Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:
Case with desiccants.

Packing Category VVI



8.4.6 Double Case – Packing Category VII


8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

243

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 11 | OF 52 |

8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction


- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

| | | |
|---|--|--------------------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 |
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 0 DATE 10/08/2010 |
| | | SHEET 12 OF 52 |

8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
 - Wooden/cardboard packing cases.
 - Plywood cases.
- Are to be adapted to pallets used for air transportation.

9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:


The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 13 | OF 52 |

The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 Sling Plate


To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10


9.3.1.6 Other Requirements

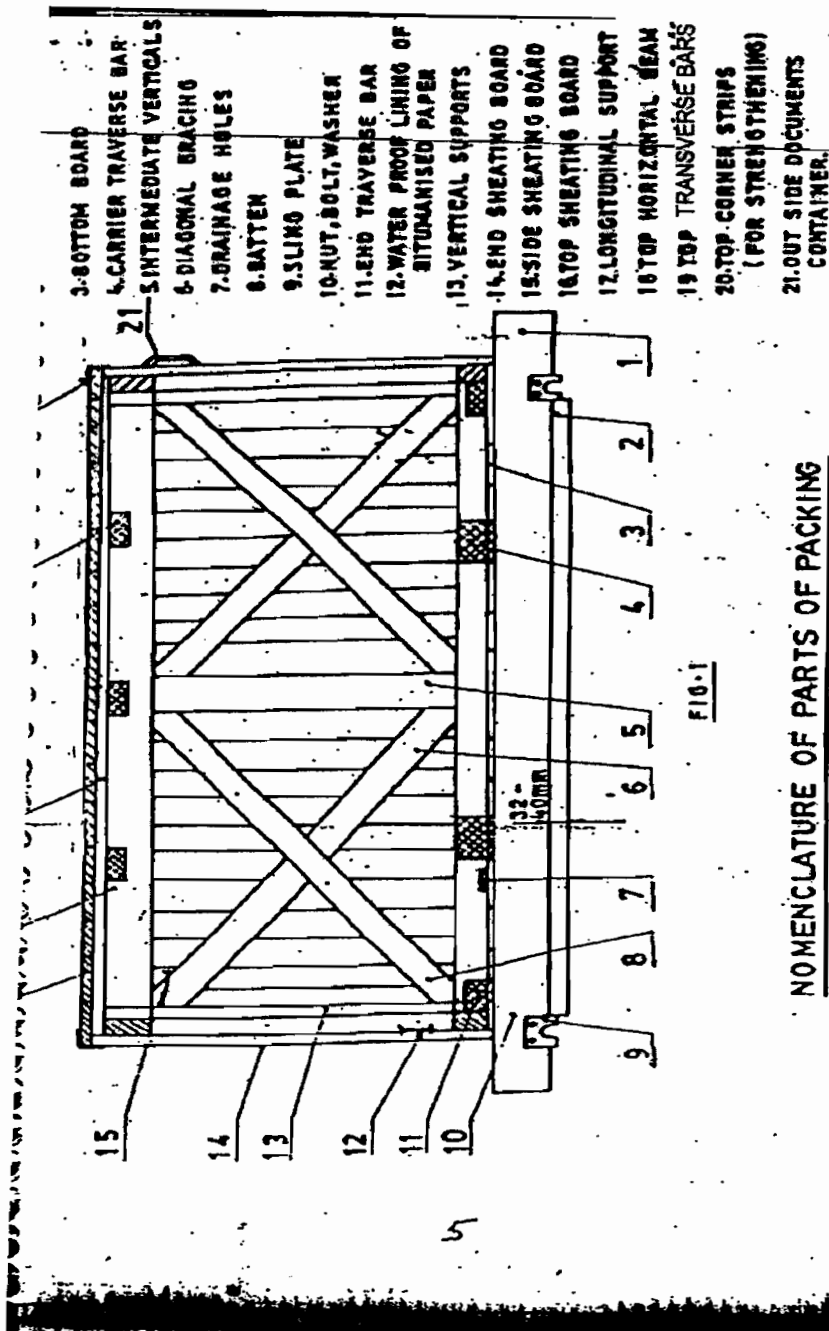
- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 14 | OF 52 |

shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 15 | OF 52 |



**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

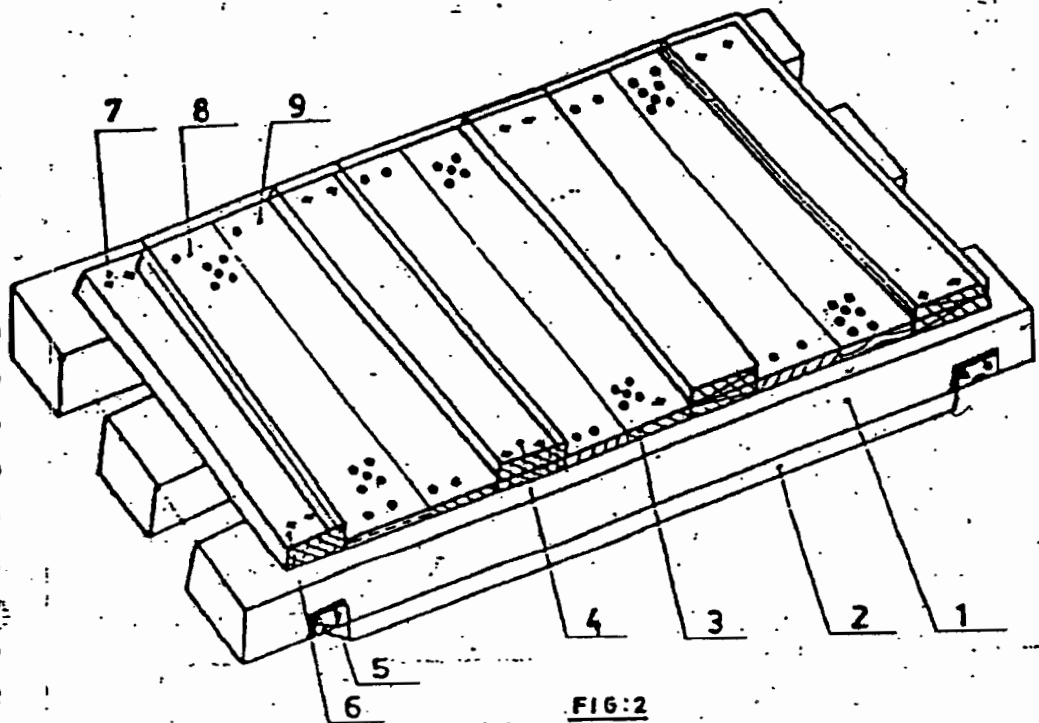
SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 16 OF 52


BOTTOM FRAME ARRANGEMENTS

Nos. of slides: Minimum 2 Nos.
For length more than 1800 mm or
load more than 1000kg, Nos. of
slides shall be minimum 3 Nos.

For dimensions of slides, refer Table 1
Cross section of end traverse bar; 100x100mm
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

027

| | | | | |
|---|---|--|--------------------------------------|-----------------|
|  | TITLE | | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | | VOLUME II B | |
| | | | SECTION D | |
| | | | REV. NO. 0 | DATE 10/08/2010 |
| | | | SHEET 17 | OF 52 |

TOP FRAME ARRANGEMENT

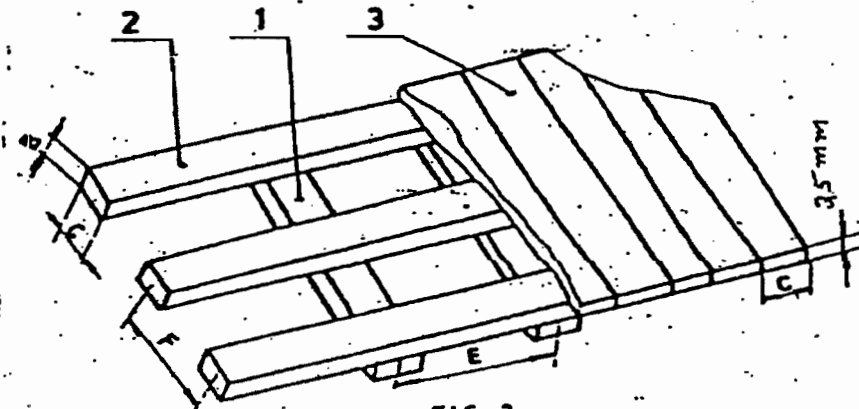
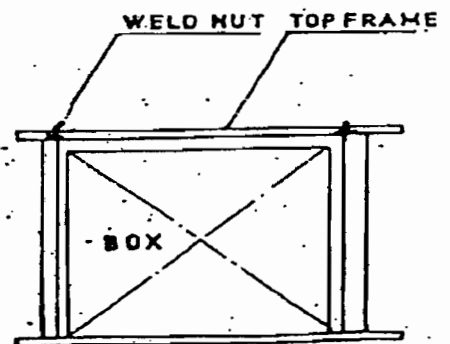
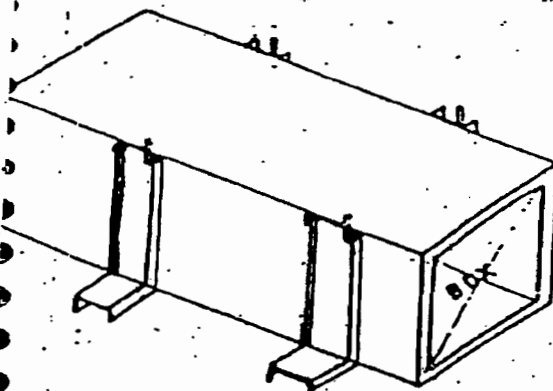


FIG-3


F : 700 to 1000 mm
E : 500 to 900 mm
30x100 mm

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES



028

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 18 | OF 52 |

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

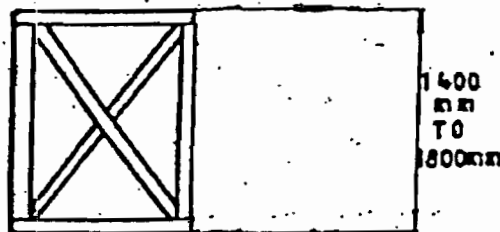


FIG: 6

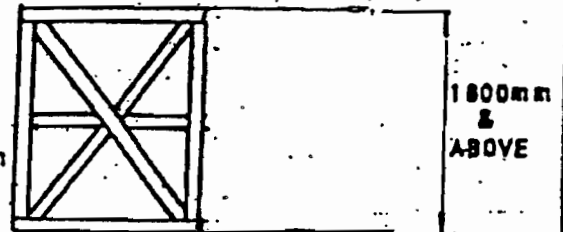


FIG: 8

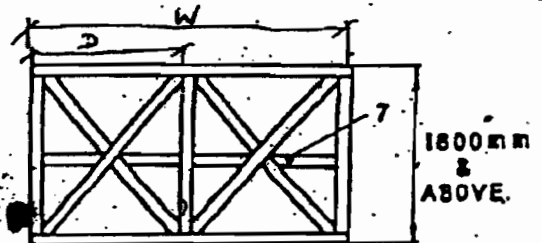


FIG: 7

7- Middle Horizontal Support

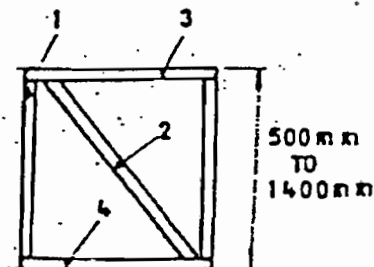


FIG: 5

1- Vertical Support

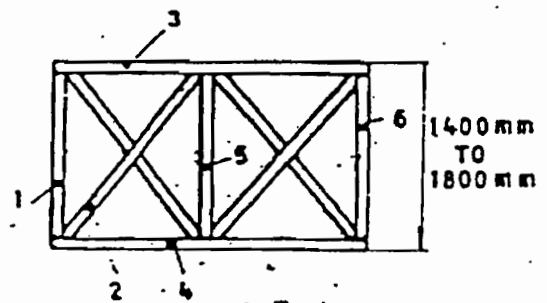



FIG: 7

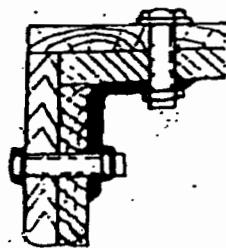
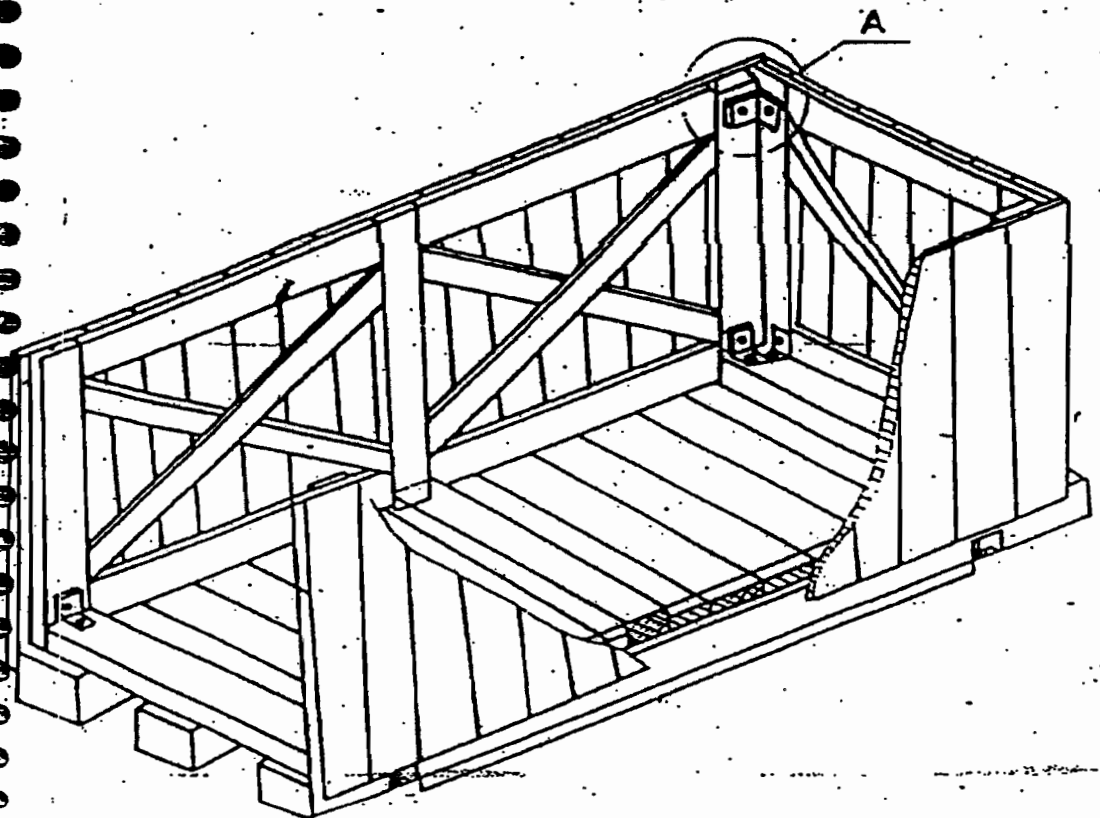
1, 5, 6 - Vertical Support

029

251

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 19 | OF 52 |

ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

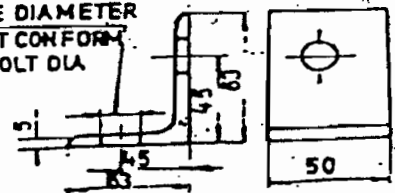



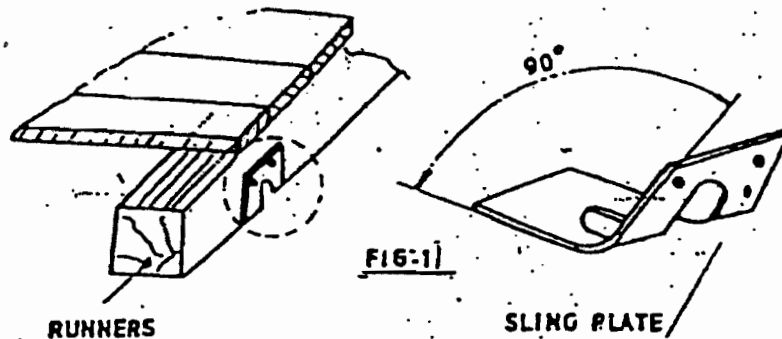
FIG:10

252

030

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 20 | OF 52 |

ARRANGEMENT OF SLING PLATE ON CASES



253


| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 21 | OF 52 |

TABLE-1

| LOADS | LENGTHS OF SLIDES | | | | | | |
|-------|------------------------|-----------------|-----------------|-----------------|---|-----------------|-----------------|
| | 600 | 800 | 1000 | 1200 | 1300 | 1500 | 2000 |
| | Cross section b x c | | | | <div style="border: 1px solid black; display: inline-block; width: 80px; height: 20px; vertical-align: middle;"></div> c b | | |
| 500 | 50 X 100 | 50 X 100 | 50 X 100 | 50 X 100 | 75 X 100 | 75 X 100 | 100 X 100 |
| 800 | 50 X 100 | 50 X 100 | 75 X 100 | 75 X 100 | 75 X 100 | 75 X 100 | 100 X 100 |
| 1000 | 75 X 100 | 75 X 100 | 75 X 100 | 100 X 100 | 100 X 100 | 100 X 110 | 100 X 150 |
| 1500 | 75 X 100 | 75 X 100 | 100 X 100 | 100 X 100 | 100 X 100 | 100 X 150 | 100 X 150 |
| 2000 | 75 X 100 | 100 X 100 | 100 X 100 | 100 X 150 | 100 X 150 | 100 X 150 | 150 X 150 |
| 2500 | 75 X 100 | 100 X 100 | 100 X 150 | 100 X 150 | 100 X 150 | 150 X 150 | 150 X 150 |
| 3000 | 100 X 100 | 100 X 150 | 150 X 150 | 150 X 150 | 150 X 150 | 150 X 150 | 150 X 150 |



| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 22 | OF 52 |



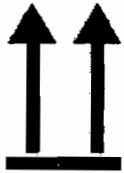




Table-2

| End and side panels | Width of the panel "W" | Distance between longitudinal support (Dimension "D") | | | | | | |
|---------------------|------------------------|---|-----|------|------|-------------|------|------|
| | | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 |
| | | Cross section b x c | | | | Item 1 to 7 | | |
| Fig- 5 to Fig-9 | 600 to 1200 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| | | X | X | X | X | X | X | X |
| | 1201 to 1600 | 100 | 100 | 100 | 130 | 130 | 130 | 130 |
| | | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| | 1601 to 2000 | X | X | X | X | X | X | X |
| | | 130 | 130 | 130 | 130 | 130 | 130 | 130 |
| | 2001 to 3000 | 30 | 30 | 30 | 30 | 30 | 30 | 40 |
| | | X | X | X | X | X | X | X |
| | 3001 to 4000 | 130 | 130 | 130 | 130 | 130 | 130 | 150 |
| | | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| | | X | X | X | X | X | X | X |
| | | 150 | 150 | 150 | 150 | 150 | 150 | 150 |

255

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 23 | OF 52 |

INDICATION MARKS ON CASES/BOXES/CRATES

| Designation | Symbol | Explanation |
|---|---|--|
| Fragile, Handle with care |  | The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung. |
| Use no hooks |  | Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo. |
| Top |  | The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided. |
| Keep away from heat (solar radiation) |  | Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful. |
| Protect from heat and radioactive sources |  | Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity. |
| Sling here |  | The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side. |
| Keep dry |  | Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins. |


| | | | |
|--|--|--------------------------------------|-----------------|
| | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 24 | OF 52 |

| | | |
|--------------------------------|--|---|
| Center of gravity | | This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other. |
| No hand truck here | | The absence of this symbol on packages amounts to permission to use a hand truck on them. |
| Stacking limitation | | The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer. |
| Clamp here | | Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else. |
| Temperature limitations | | According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note. |
| Do not use forklift truck here | | This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides. |
| Electrostatic sensitive device | | Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days. |

| | | | |
|--|--|---|------------------------|
| | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 25 | OF 52 |

| | | |
|---------------------------|--|---|
| Do not destroy barrier | | A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants". |
| Tear off here | | This symbol is intended only for the receiver. |

FIG-12

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 26 | OF 52 |



| | | | | | |
|---|--|--|--|------------------|--|
|  | | BHEL-PEM-DEWHI-INDIA | | | |
| CONSIGNEE | | | | | |
| MATERIAL | | | | | |
| CUSTOMER REF. | | MO. NO. | | | |
| DESPATCH ADVICE NOTE NO. | | CASE NO. | | | |
| DIMENSIONS(MM) LXBXH | | NET WT -KGS | | GROSS WT -KGS | |
| SPECIAL INSTRUCTIONS | | HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT | | | |

FIG-13. MARKING PLATE

259

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 27 | OF 52 |

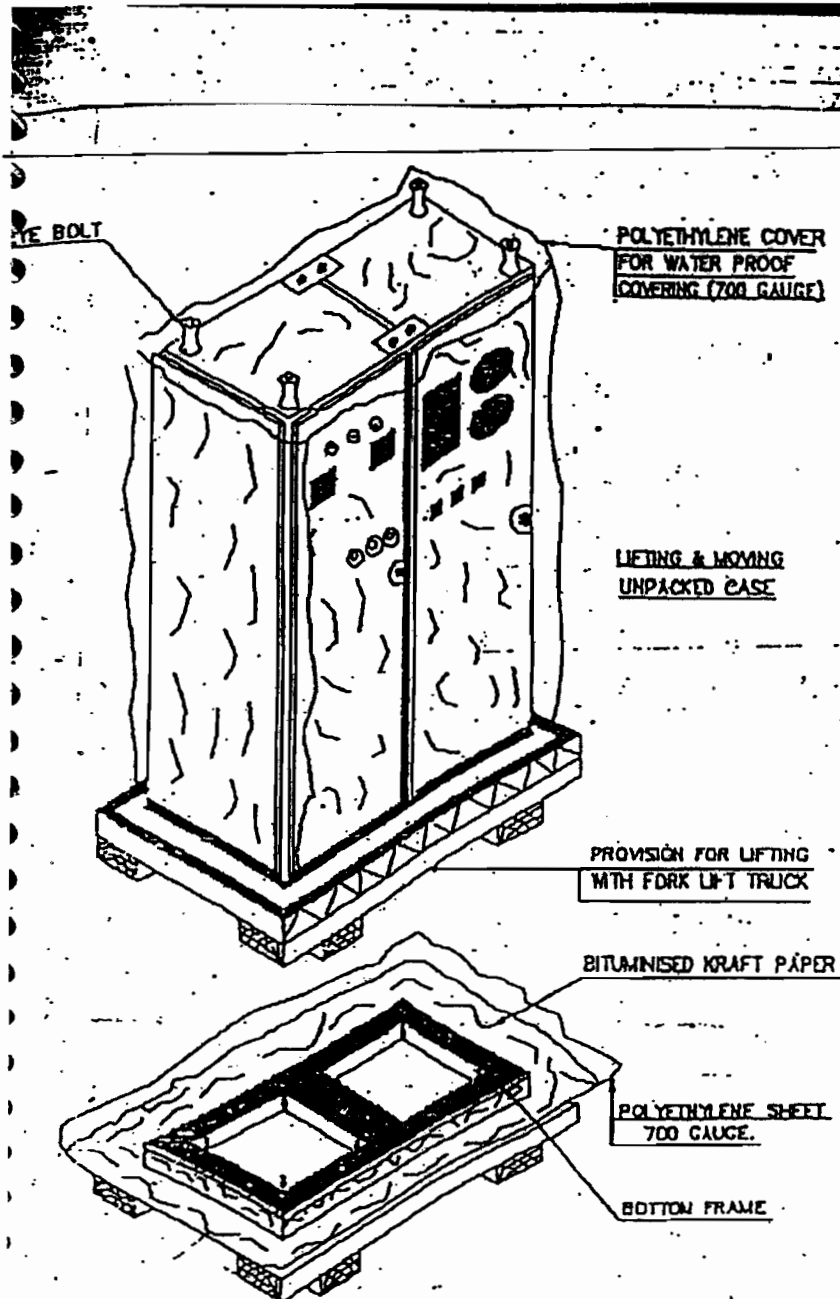



FIGURE-14

260

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME | II B |
| | | SECTION | D |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET | 28 OF 52 |

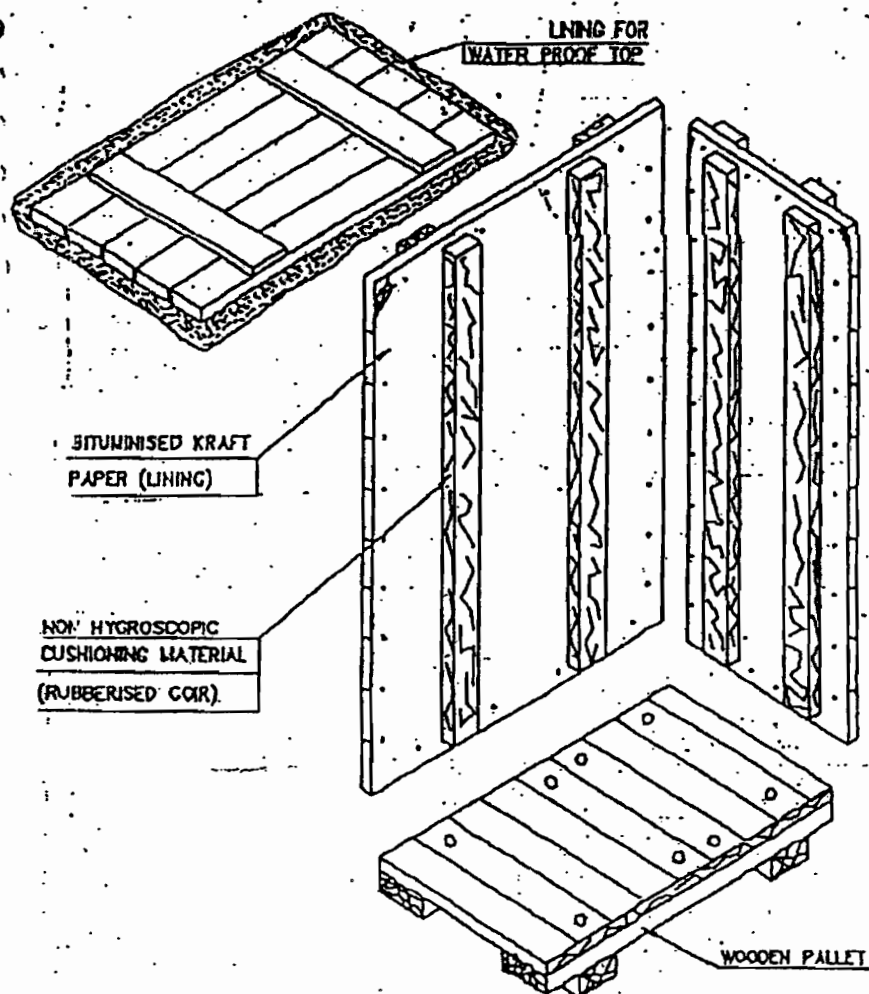



FIGURE-15

261

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 29 | OF 52 |

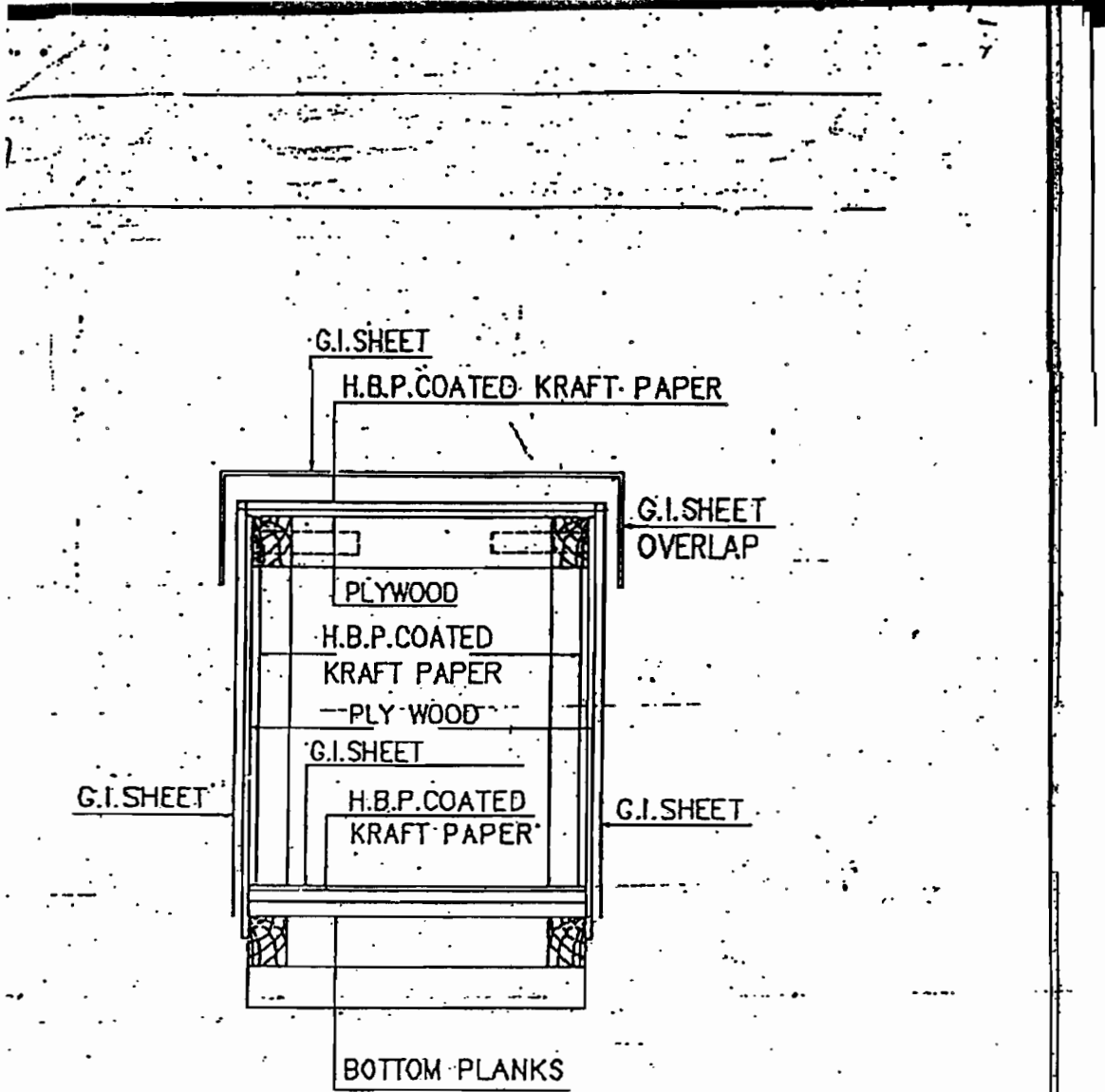



FIG-16 : CLOSED PACKING CASE WITH G.I. SHEET
SHOWING LAYERS OF PACKING MATERIALS.

262

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 30 | OF 52 |

10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- Project Name
- Purchase Order No.
- Sl. No. of package
- Size of mattress (Thickness x Length x Width)
- Density
- Wire netting material and size
- Weight of the package


10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

- Strapping of coil with polyester strap around circumference at one place.
- Putting paper I. D. Edge protector.
- Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- Wrapping the coil with HDPE film.
- Covering the coil including its build up & bore with masonite / particle board.
- Putting metallic I. D on coil.
- Putting O.D edge protector (paper) on coil.

263

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 31 | OF 52 |

- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

- a. Strapping of coil with polyester strap around circumference at one place.
- b. Putting paper I. D. Edge protector.
- c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- d. Wrapping the coil with HDPE film.
- e. Covering the coil including its build up & bore with masonite / particle board.
- f. Putting metallic I. D on coil.
- g. Putting O.D edge protector (paper) on coil.
- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
- i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
- j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.


Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.


10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 32 | OF 52 |

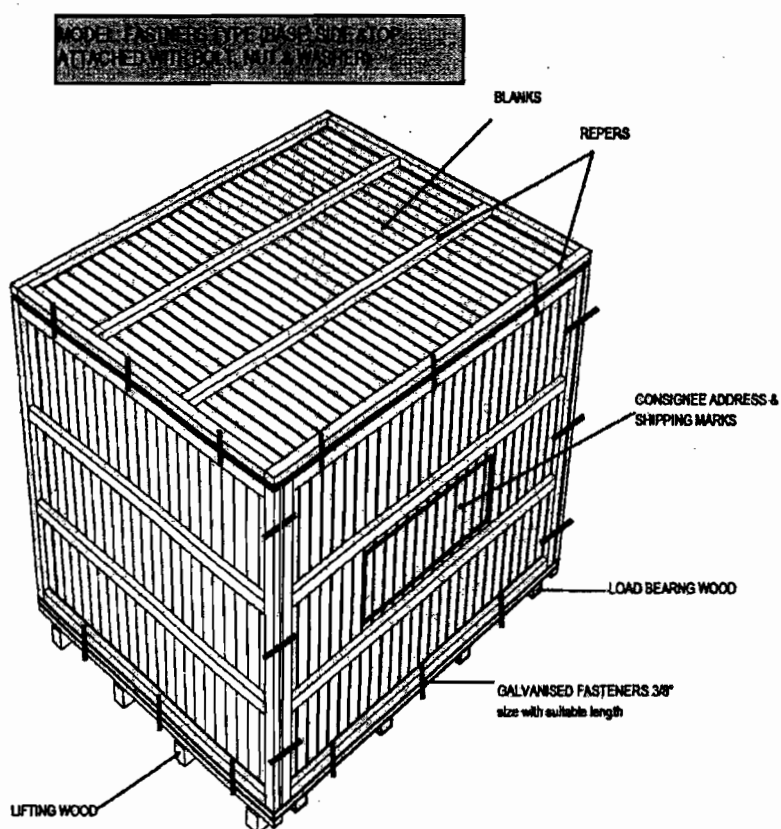
- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

265

| | | |
|---|--|--------------------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 |
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 0 DATE 10/08/2010 |
| | | SHEET 33 OF 52 |


This Type of case to be used for following items:

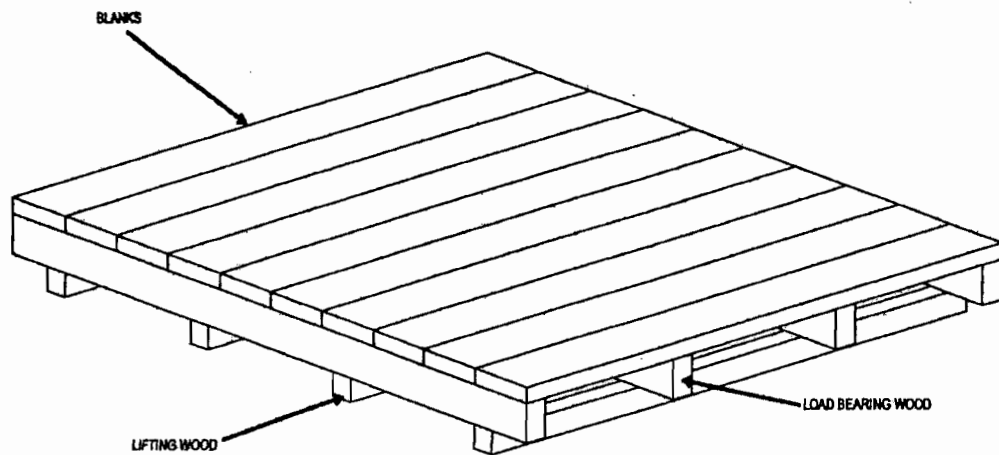
1. BALL SEPERATOR
2. BALL COLECTOR SKOD



SHEET 05 of 10


266

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 34 | OF 52 |

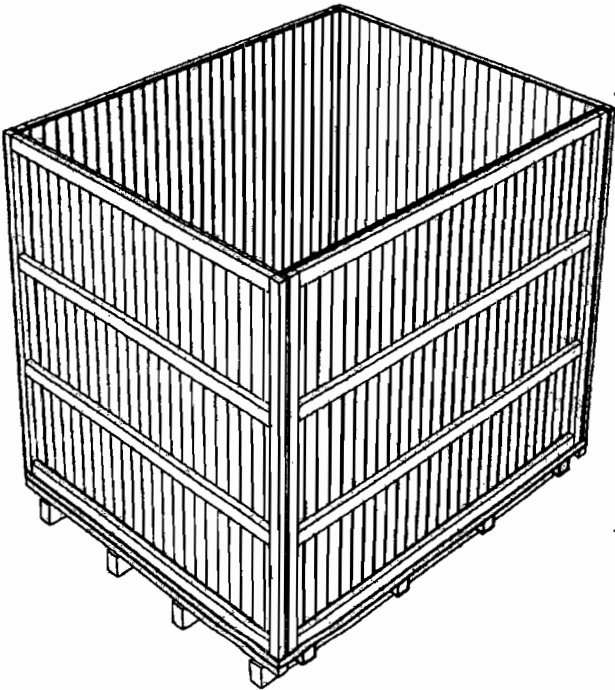



SHEET 06 of 10

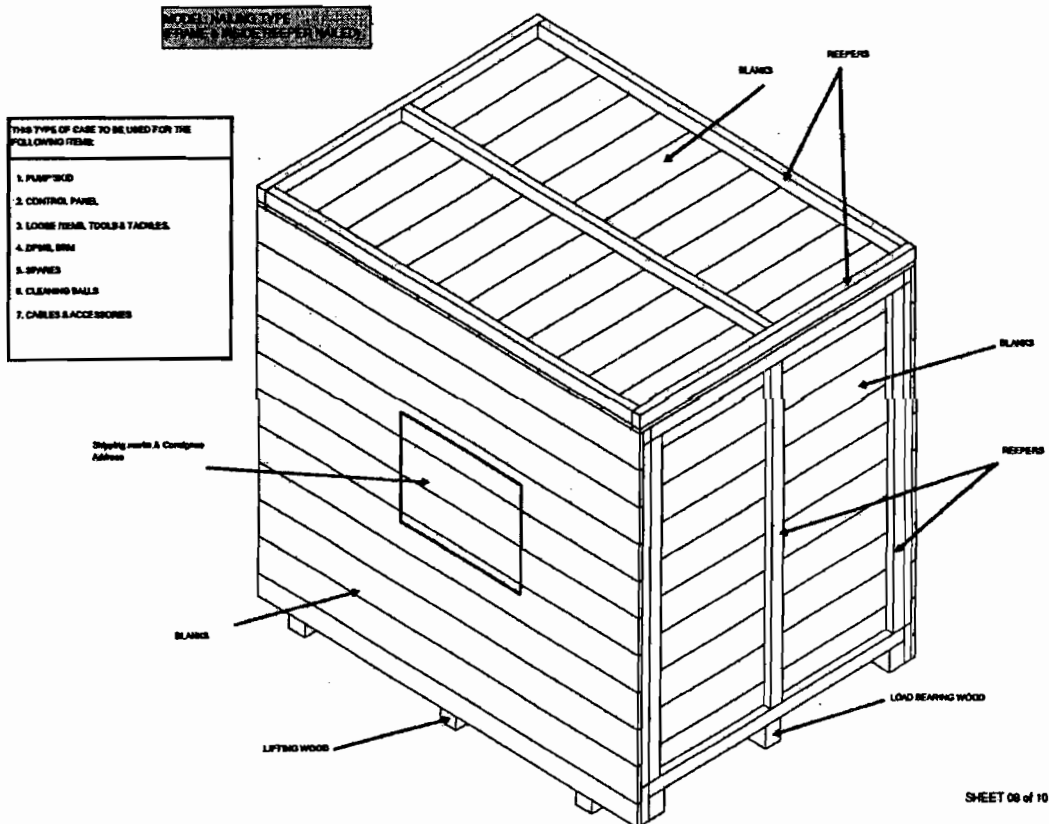
267

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 35 | OF 52 |

NOTED AS IS WITHOUT JOE




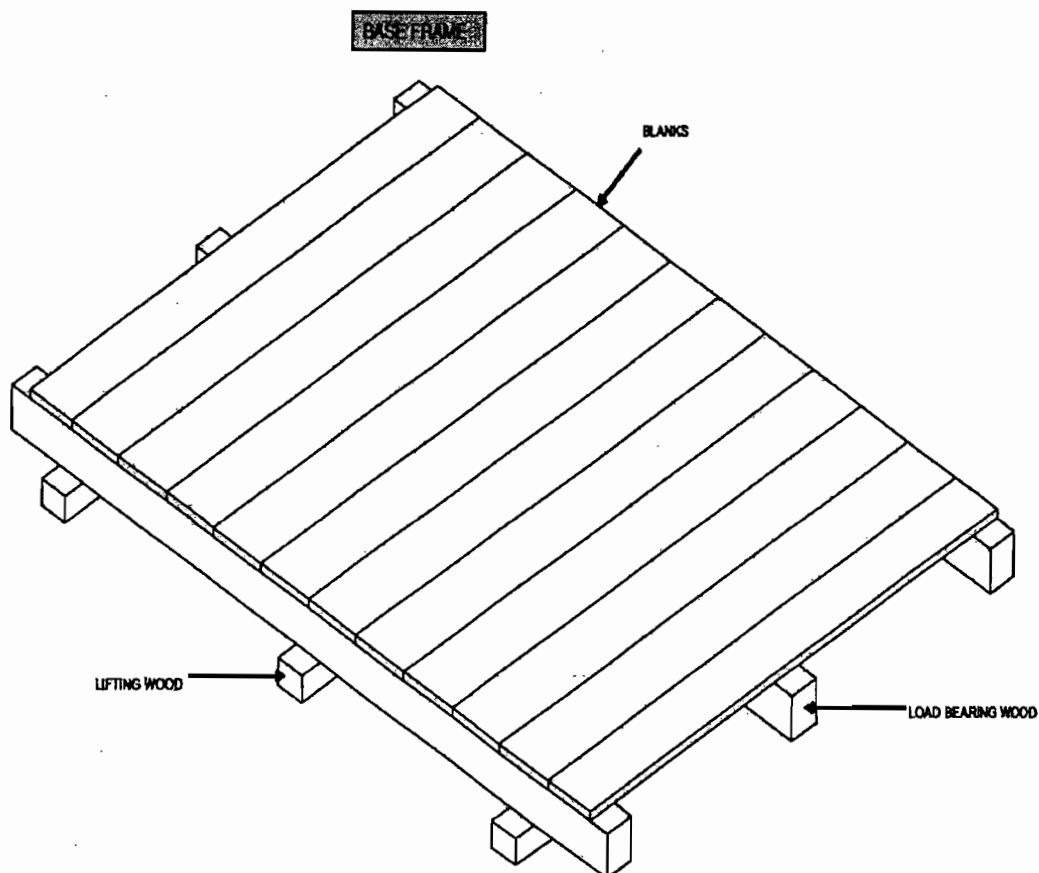
| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 36 | OF 52 |



SHEET 08 of 10


269

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 37 | OF 52 |

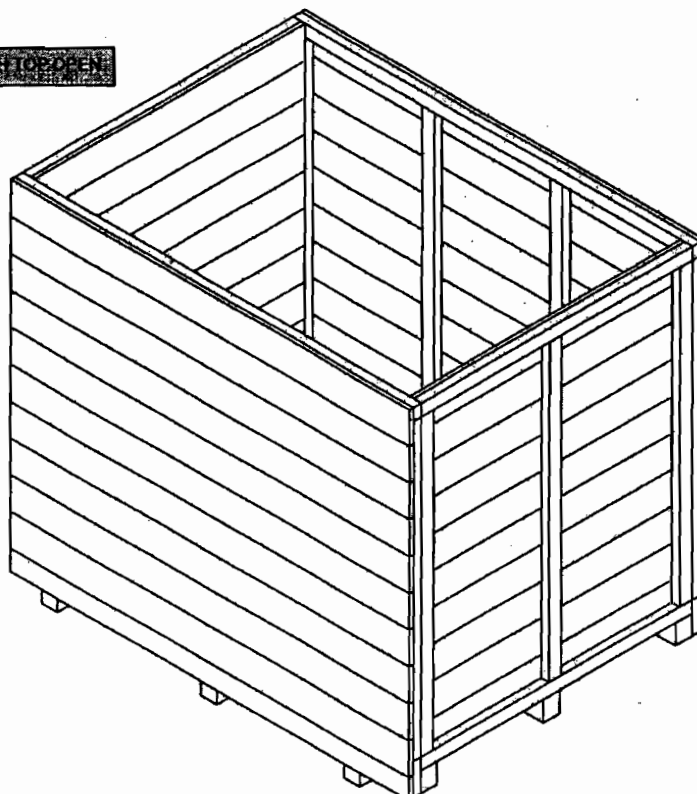


SHEET 09 of 10

270


| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 38 | OF 52 |

WALING TYPE MODE WITH TOP RAIL



SHEET 10 of 10

271

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 39 | OF 52 |

10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.


11.0 PACKING OF ELECTRICAL ITEMS

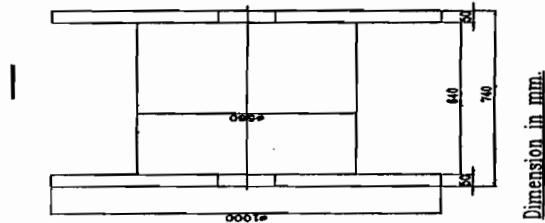
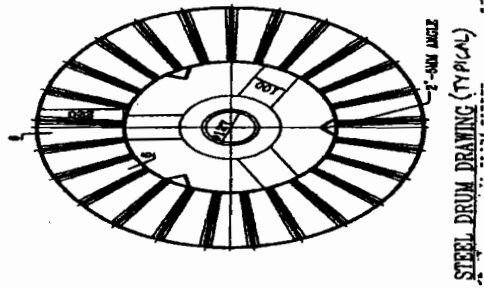
11.1 CABLES

11.1.1 Type of Equipment All type of cables..


11.1.2 Type of Construction

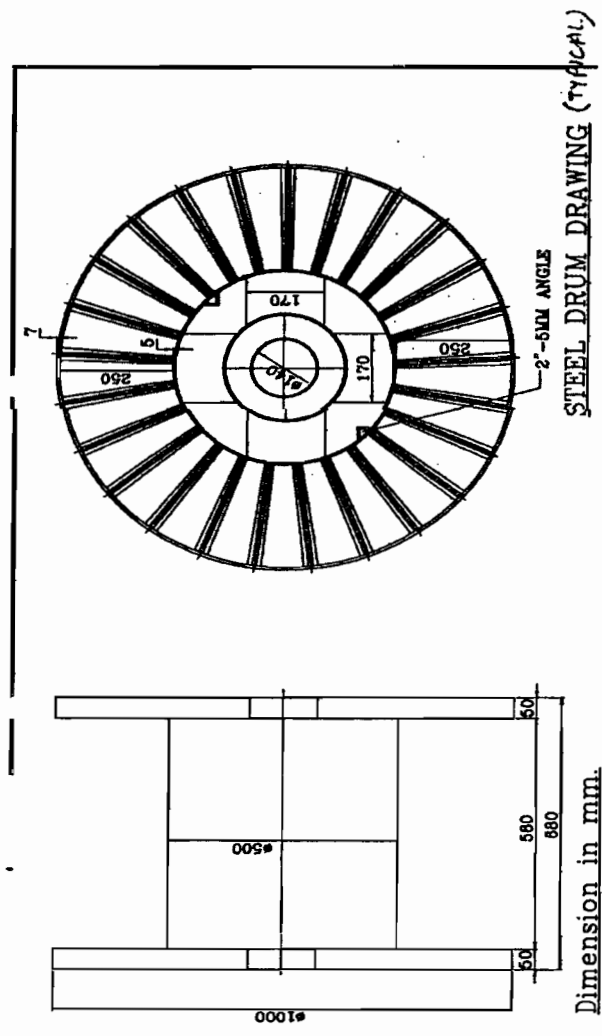
New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 40 | OF 52 |



273


| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 41 | OF 52 |




11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

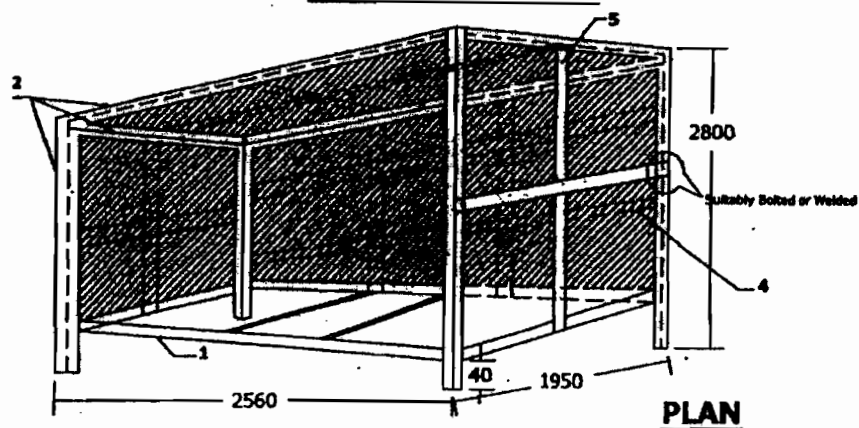
- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME | II B |
| | | SECTION | D |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET | 42 OF 52 |

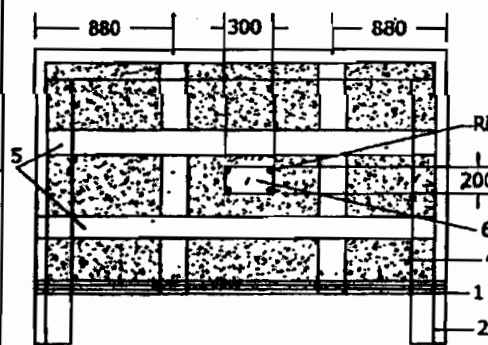
- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

| | | |
|---|--|--------------------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 |
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 0 DATE 10/08/2010 |
| | | SHEET 43 OF 52 |

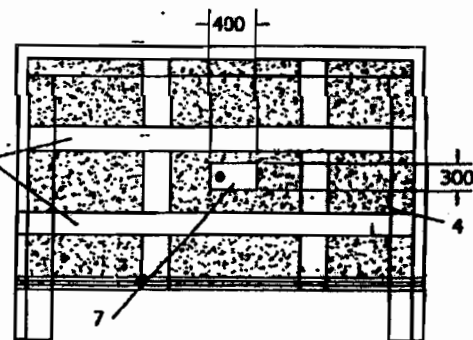
STEEL PACKING (TYPICAL DETAILS)



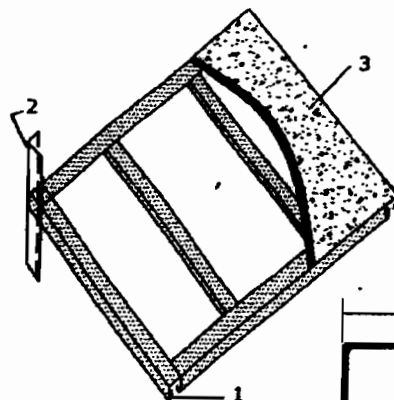
PLAN



FRONT SIDE OF BOX



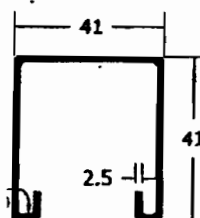
BACK SIDE OF BOX




BOTTOM FRAME ARRANGEMENT

Note:-

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.5mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.



DETAILS OF "C" CHANNEL

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 44 | OF 52 |

11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DIATRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMIOSSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMBALES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE


As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES


Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 45 | OF 52 |

Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 46 | OF 52 |

PACKING PROCEDURE FOR CONDUIT PIPE

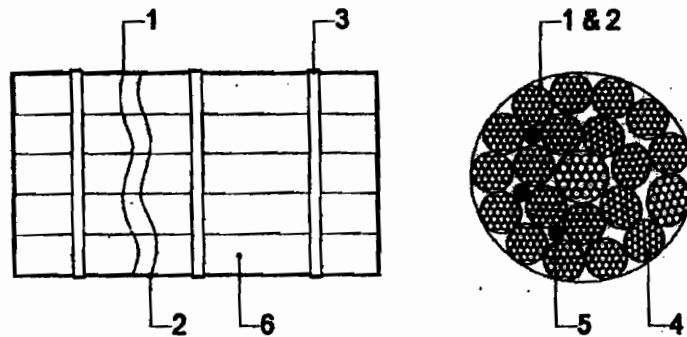



FIGURE "A"

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 47 | OF 52 |

PACKING PROCEDURE FOR STRUCTURAL STEEL

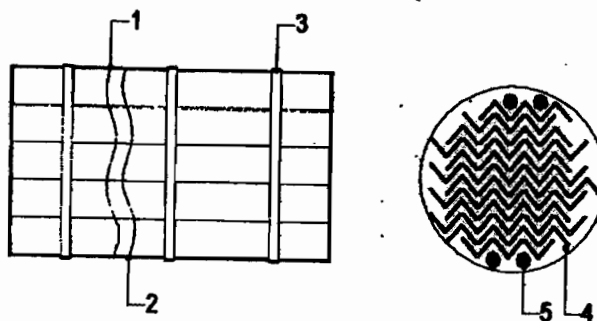


FIGURE "B"

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

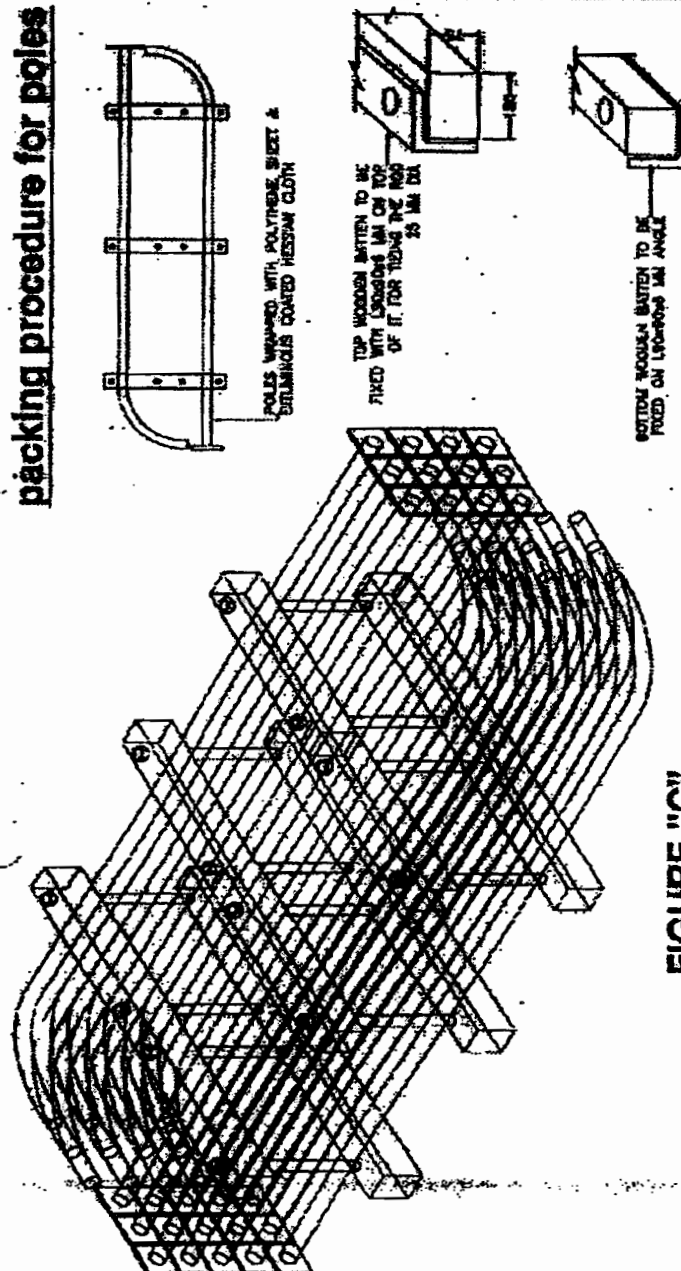
SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B


SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 48 OF 52

packing procedure for poles**FIGURE "C"**

281

| | | | |
|---|--|---|------------------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 49 | OF 52 |

11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocol of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
 - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
 - ii) Hardware items shall be packed in polyethylene bags (Thickness ≥ 0.175 mm) with item slip
 - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
 - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
 - f) Galvanized Steel straps are provided for binding the packing box sides.
 - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.


11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

282

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 50 | OF 52 |

- small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.


Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).
The maximum inside dimensions of containers are to be considered:

283

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 51 | OF 52 |

- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints.

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.


BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS.

VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

| | | | |
|---|--|--------------------------------------|-----------------|
|  | TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS | SPECIFICATION NO. PE-TS-888-100-A001 | |
| | | VOLUME II B | |
| | | SECTION D | |
| | | REV. NO. 0 | DATE 10/08/2010 |
| | | SHEET 52 | OF 52 |

useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.

285

| Bharat Heavy Electricals Limited International Operations - Projects Division Integrated Office Complex, Lodhi Road New Delhi -110003 | | | |
|--|----------|---|--|
| 400 MW MARIB GAS TURBUINE POWER STATION PHASE-II | | | |
| Following dispatch instructions for effecting supplies under the above contract are being issued for compliance by all the units involved in this project. | | | |
| Sr. No. | Item No. | Details | Action By |
| 01 | 01 | <u>Purchaser's Name and Address:</u> Public Electricity Corporation Airport St P.O. Box 178 Sana'a Republic of Yemen Attention: Eng. Abdul Mumen M. Mutaheer Managing Director Tel : (967 1) 328 141-142 Fax : (967.1) 328 150 E-mail : YPECNT@Y.net.ye | For information |
| 02 | 01 | <u>Delivery Terms:</u> DAP (Marib Site YEMEN) Public Electricity Corporation Airport St P.O. Box 178 Sana'a Republic of Yemen | Units to ensure proper marking on the boxes so as to identify the final destination clearly. |
| 03 | 01 | <u>Seller's Name and Address:</u> Bharat Heavy Electricals Limited International Operations Division Lodhi Road Integrated Office Complex New Delhi -110003, INDIA | For information |
| 04 | 01 | <u>Payment Terms for Equipment Supply:</u> <u>Contract Terms:</u> Advance - 10% of the Contract price. Supply- 80% on submission of shipping documents 5% on the receipt of Taking over and Acceptance Certificate and 5% on the receipt of Final Acceptance Certificate | All Units |
| 05 | 01 | <u>Shipping Marks :</u> As Per LC (Copy Enclosed) | All Units |
| 06 | 01 | <u>Consignee:</u> As per LC (Copy Enclosed) | All Units |
| 07 | 01 | <u>Notifying Party :</u> As Per LC (Copy Enclosed) | All Units |

| | | | |
|----|--|--|-----------------------|
| 08 | Packing Instructions & Inspection Prior to Dispatch by Supplying Units/Sub-Vendors: | | All Units & Suppliers |
| | 01 | Packing (tare) shall be part of the Equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of Equipment during transportation. In case of Equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated. | All Units/Suppliers |
| | 02 | <u>Special instructions from PEC Yemen :</u> | |
| | 02.1 | All equipment and instruments should be fully packed and protected from damage during transportation and field storage. All machine surfaces should be protected with planks or similar materials and reinforced with metal strips or plates from the outside. | All Units/Suppliers |
| | 02.2 | All electrical / electronics equipment such as motor, switch, control device, instrument and component should be sealed with polyethylene insulation and a corresponding drying agent should be provided. | All Units/Suppliers |
| | 02.3 | For all piping ends as well as pipes and tanks, the openings should be protected from damage and sealed to avoid getting affected by particulates, moisture and air. These Protection measures should be kept intact before the start of installation or moving for periodic inspection. The cost spent for the moving, modification and replacement of the packing and protection device would be paid by the BHEL. | All Units/Suppliers |
| | 02.4 | A waterproofed packing list should be provided in each planks or packing case. The name of articles in the packing case should be marked clearly on the packing list so as to be identified easily. | All Units/Suppliers |
| | 02.5 | The articles in the case should be supported by wooden bars in order to be fixed safely and it should not be wedged individually with wooden pad. The marks outside the case should be printed with climate proof materials or paints so as to be protected from being removed during transportation. | All Units/Suppliers |
| | 02.6 | All materials and equipment should be packaged according to the typical environmental conditions during storage. In case of severe conditions, these materials and equipment should be packaged carefully by taking a full and appropriate preventive measure to protect from any damage or wear. The marks should be painted or printed clearly and durably with characters of 40 mm height at minimum on both ends of the packing case. The labels should be well protected to prevent loss / tempering. | All Units/Suppliers |
| | 02.7 | A mark indicating the correct lifting position should be shown by an arrow on the packing case. | All Units/Suppliers |
| | 02.8 | <u>Preparation for Shipment of Operational Spare Parts</u> | |
| | 02.8.1 | Shipping preparations shall be of export quality and crating shall adequately protect the items against injurious corrosion, dampness, breakage, or vibration that might be encountered in their transportation and handling. BHEL to submit a detailed packing and crating procedure to PEC on a parent equipment basis at least sixty calendar days prior to shipment. | All Units |
| | 02.8.2 | Operational spare parts shall be crated on a parent equipment on exclusive basis and there shall be no common crating of unrelated spare parts. For items too small to be individually crated, they have to be crated on the same kind of equipment basis under condition that they are classified and packed in a vinyl bag or small box on a parent equipment basis. | All Units |

| | | |
|--------|---|---------------------|
| 02.8.3 | To the extent that BHEL intends to utilize containers in the shipment of operational parts, BHEL shall utilize good quality shipper owned or nonreturnable containers which should be conveyed to Owner before its receipt at the Site. | All Units/ROD |
| 02.8.4 | All shipments of operational spare parts shall be consolidated prior to shipment and shall be transported to the Site in accordance with the contractual shipping schedule. BHEL shall not make partial or multiple shipments of operational spare parts for the same parent equipment item without prior approval of Owner. | All Units |
| 02.8.5 | BHEL shall submit schedules identifying completion of fabrication, ship date and site delivery dates for the operational spare parts on a parent equipment basis. | All Units |
| 02.8.6 | To the greatest extent practicable , BHEL shall individually tag each Operational Spare Part. The tagging data shall include the Contract number, Item number and the part identification number. Where such individual tagging is impracticable due to the size or quantity of certain operational spare parts the tagging data shall be fixed to the permanent packing of these operational spare parts. | All Units/Suppliers |
| 02.8.7 | BHEL shall prepare packing lists in strict accordance with the tagging requirements and shall reference the Exhibit C, Section 3. Item numbers of the individual operational spare parts including required quantities. Contractor shall include on the packing list the net weight of operational spare parts exceeding 300 Kg. Packing lists shall also provide a certification verifying that the packing list quantities constitute "Partial" or "Complete" shipment of all required quantities of operational spare parts. | All Units/Suppliers |
| 02.8.8 | All packages to be wrapped in <u>Sealed transparent polythene</u> inside the crates for effective weather proofing | All Units/Suppliers |
| 03 | Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: Destination Package number: BHEL/YMN/XXX/YYY/ZZZZ where XXX stands for Unit abbreviation e.g. HWR , HYD ,EDN, PEM, RPT etc YYY stands for Vendor abbreviation Following series of ZZZZ should be used by Different Units HWR (10000) ,HYD (20000),PSNR (30000),PEM (40000),BPL(50000),RUD(60000), TBG(70000),TRY(80000),EDN(90000) i.e. first package dispatched from HWR should be numbered : BHEL/YMN/HWR//10001 . Gross and Net weight Dimensions Lifting places Handling marks and the following delivery marking: CONTRACT Nr. 12/2008 PURCHASER: PEC YEMEN | All Units/Suppliers |
| 04 | <u>Completeness of Contents of each packing case:</u> | |
| 04.1 | Concerned CQA/Unit QC/Third Party Inspection Agency shall verify the completeness of contents of each package w.r.t packing list both in terms of quality and quantity before authorising dispatch of the consignment. | All Units/Suppliers |
| 04.2 | Packing commensurate with international standards and accepted norms will be ensured by CQA/ Unit QC/Third Party Inspection Agency. Packing has to be sea-worthy and secure. As far as possible, the packing has to be rectangular in shape for optimum space utilization in the ship and economize on shipping costs. Projections on packages are prohibited. | CQA/All Units |

| | | |
|------|---|----------------------|
| 04.3 | The packing list has to be checked and certified by the Inspection agency (ies) with due signatures. All packages shall be enclosed in suitable GI sheets on all sides. | CQA/All Units |
| 04.4 | No loose items / Gunny bag packing are allowed for shipment. Proper pallets and crates are to be used for packing of Oil drums and Structures. | CQA/All Units |
| 05 | <u>Routing of Packing Lists:</u> Packing list is an extremely important document, which forms a part of export documentation in connection with the processing of customs formalities. Packing List has to be generated by units/Unit vendors and sent to IO and ROD, Mumbai (both at the same time), two weeks in advance, for processing and obtaining shipping bills' clearances and avoiding octroi payment through 'N' form at Mumbai. | All Units/ suppliers |
| 06.1 | <u>Advance intimation to ROD, Mumbai & IO</u> All supplying units/vendors will give at least 15 days advance intimation to ROD, Mumbai & IO along with package details before actual dispatches to arrange for storage/shipping arrangements by ROD Mumbai and customs invoicing by IO. <u>Information must be sent to consolidate the details and arrange for shipments in time.</u> | All Units |
| 06.2 | <u>Telephonic Intimation to ROD Mumbai of Movement of Vehicles:</u> Vehicle drivers to be instructed by the units to contact ROD regarding movement of vehicles on daily basis for heavy lifts, especially 2 days before arrival at Mumbai so that suitable directives can be given to the driver of the vehicle for further transportation of the goods either to docks or godown. | All Units |
| 07 | <u>Excise Attestation at Works:</u> To avoid opening of big cases for examination by customs at port of shipment, the supplying unit may arrange to get the packing cases sealed by local excise authorities/ self certification and to get the relevant invoices and packing lists endorsed from Superintendent, Central Excise. For this purpose, Units should send the packing lists to IO at least 2 weeks in advance to enable prepare Shipping Invoices for furnishing to the units for requisite attestation and sending the same to ROD Mumbai through fastest means for a smoother and faster customs clearance. Also Units to provide "specification of packing with the indication of the number of cargo packages, type of packing and weight of packing in English" along with the packing list. | All Units/ suppliers |
| 08 | <u>Provision of inspection windows on Packages:</u> Unit/Vendors should provide inspection window of size 6" x 4" (glass perplex) for customs examination for all packages (above 1.5 x 1.5 x 1.5 cu m) involving panels of any kind. Care would be taken to ensure that all packages are properly sealed to avoid ingress of moisture, rodents etc. Packing slip folders shall be attached in each box. | All Units/ Suppliers |
| 09 | <u>Transportation Drawings for Heavy Weight/ODC consignment: For any package/item weighing above 20000 kgs and/or size greater than 2.5 X 2.5 X 4 m :</u> Detailed engineering documents (at least 4 sets) for all items of the above category shall be furnished by respective units to issue shipment enquiries in a proper manner. This would include Gas Turbine ,Transformers, Lube Oil tanks,Storage Tanks (Oil and Water) and Generator. The drawing has to include center of gravity of the item clearly (Units to identify such items and notify IO as soon as the engineering documents are released). | All units |


289

| | | | |
|----|--|--|------------------------------------|
| | 10 | <u>Lifting Beams:</u> All heavy lifts for which safe handling is essential at the port of dispatch shall be accompanied by lifting beam on non-returnable basis | All Units |
| 09 | 01 | <u>Marking for Safe Handling:</u> To ensure safe handling, packing case shall be marked to show the following: <ul style="list-style-type: none"> • Upright position. • Sling position and Centre of Gravity position. • Storage category. • Fragile components (to be marked properly with a clear warning for safe handling). | All Unit |
| 10 | 01 | <u>Marine Insurance Policy:</u> Insurance Policy for 110 percent value of the contract covering all risks including war and SRCC from Port of shipment in India/Third country direct dispatches, to site shall be taken by IO Insurance Policy and it shall indicate PEC as co-insured. | IO Projects |
| 11 | Shipping Documentation including those covered by customs requirements: | | |
| | 01 | Customs Invoices: Values to be allocated by IO (Alternatively, Excise attested invoices where the package is sealed and dispatched by the units) | ROD/ IO Projects/ All Unit |
| | 02 | Packing List | All Units /Sub-vendors of units |
| | 03 | ARE1 forms/Excise Invoice corresponding to Unit invoice values and Delivery challans. | All Units /Sub-vendors of units |
| | 04 | Chartered Engineer's Certificate, applicable to be arranged by Units. Care should be taken to ensure that usage of the materials shown in C.E. certificate out of DEPB goods is not disproportionate. | All Unit/ROD |
| | 05 | Catalogues/literature/write-up in case of customs endorsement for discharging exports obligation in case of DEEC imports to be made available to ROD before arrival of goods in the city of port of dispatch. | All Unit |
| | 06 | Unit's sub-vendors, whose responsibility of supply is upto FOB, can make their own arrangements of Customs House Agents as well as Octroi clearance, apart from physical examination of the cargo at the port of dispatch and make arrangements of loading on BHEL's nominated vessel. BHEL, in such a case, through ROD would arrange to furnish a copy of the shipping invoice to CHA of sub-vendors. All units to keep ROD Mumbai informed in this regard about the arrangements made with sub-vendors. | All Units/ Suppliers/ROD |
| | 07 | To avoid any problem with Octroi post at Mumbai & Customs, the values appearing in Unit invoice sent with the cargo shall be preferably within $\pm 10\%$ of IO-Projects shipping invoice value. | All Units/Rod |
| | 08 | <u>Octroi Clearance:</u> Drivers/Escorts carrying the export cargo for this project on behalf of the units to be advised to contact the agents at Octroi Naka:(To be intimated by RODMumbai) Copies of the dispatch documents must be sent to ROD Mumbai by i) Fax ii) e-mail through scanning of the documents with copy to IO | All Units/Rod |
| 12 | | <u>Full Set of Clean Multimodal Transport Document:</u> Complete set of shipping B/L showing freight prepaid as per the rates of regular shipping lines. In case of Air Freight consignment, one original of AWB is required together with three copies of the same. | ROD/ IO Projects |

| | | | |
|----|--|--|----------------------|
| 13 | | <u>Certified Inspection Certificate Approved by Customer:</u> The certificate signed by PEC Inspector (if equipment tested in presence of PEC representative) is to be provided to IO . In case the Certificate is signed by BHEL/Third Party Inspection Agency, it is to be provided by Units/ suppliers to IO and IO will get it approved from PEC. | All Units/ Suppliers |
|----|--|--|----------------------|

| | | | |
|----|--|--|----------------------|
| 14 | Shipping Carrier Specification and related Requirements: | | |
| | 01 | Certificate of Freight having been pre-paid as per the regular shipping lines is required on MTDs. | ROD/ IO Projects |
| | 02 | Subject cargo would be generally shipped under the deck. Specific confirmation/clearance of IO is needed for shipment on deck. | ROD/ IO Projects |
| | 03 | Vessel age to be restricted as per insurance policy in force Buyer's Reference (Contract No.) is required on B/Ls. | ROD/ IO Projects |
| | 04 | For Third Country Supplies , concerned units will ensure all the above certificates in addition to Certificate of Origin. | All Units/ Suppliers |
| 15 | Guidelines for Dispatches from Units/Indian Vendors: | | |
| | 01 | Vehicle drivers shall carry ARE1 in photocopy (3 originals to be sent to ROD). Each consignment carried by the vehicle shall have a separate ARE1 and it must be ensured that materials under one ARE1 get transported in the same truck/trailer. In order to avoid any problems at port of dispatch from the point of view of i) shipping bill preparation and passing thereof ii) 'N' form at Octroi check post and iii) control and movement of cargo within Mumbai and iv) physical examination of cargo by customs, the materials under the same category e.g. a) DEEC cargo b) Free shipping bill cargo c) DEPB (duty entitlement pass book scheme) and d) duty drawback must be sent in the same truck/trailer. Units to ensure that ROD is communicated very clearly the type of shipping bills to be prepared, well before the materials are dispatched from the works. | All Units |
| | 02 | <u>All materials to be dispatched under intimation to:</u> Senior Manager(Exports) Bharat Heavy Electricals Limited Regional Operations Division 14th Floor, World Centre 1, Cuffe Parade Mumbai-400005 Attention: Mr.Sanjeev Shikhare Telephone No.: 22171302 (Mumbai) | All Units/Rod |
| | 03 | <u>Clearing Agents:</u> All materials to be dispatched to Mumbai on door delivery basis, freight prepaid to the address of the clearing agents(to be specified by ROD, from time to time) | All Units/Rod |
| 16 | 01 | <u>Customs formalities Period:</u> Packages arriving at the port shall have a minimum time of 3 working days for customs examination and other related formalities in respect of the cargo under shipment. The goods received after arrival of the ship may not be loaded if either sufficient time does not exist or space available in the ship is booked by the carrier for other exporters due to lack of availability of the goods at the port in time for shipment from BHEL. In cases, where the committed cargo to the carrier based upon information received from all the units does not reach in time of scheduled shipment at the port of dispatch, IO-Projects would be within its right to decide the priority of loading as per the project schedule requirements given the condition that adequate space in the ship is not available to accommodate the cargo. | For information |
| 17 | 01 | <u>Triplicate ARE1 forms for Cancellation of Bonds:</u> It is necessary that the units ensure that ARE1 forms are sent in Triplicate to ROD Mumbai. After ROD Mumbai effects the shipment, endorsement of customs on triplicate copy of ARE1 form would be obtained by ROD Mumbai and sent to the concerned unit within 6 to 8 weeks for cancellation of the excise bond. | Units/ ROD Mumbai |

| | | | |
|----|----|---|-------|
| 18 | 01 | <u>Formalities in Connection with 'N' form:</u> After the shipment is effected, requisite formalities indicating physical export of the goods earlier exempted from payment of Octroi at Mumbai will have to be ensured. Units to ensure this from their sub-vendors because In past , Octroi notices from Mumbai municipal corporation were received and 'N' form facilities were withdrawn at times. | Units |
| 19 | 01 | <u>Shipping Procedures and ROD Responsibilities:</u> Consolidation of Packages and Storage in Warehouse: ROD Mumbai either themselves or through their CHA would ensure following: <ul style="list-style-type: none"> • Proper storage of goods at an elevated level if store is in open to avoid damages to the consignment during rainy season (All the packages to be covered with a proper tarpaulin in open storage). • All Electrical and C&I items to be stored indoors. • Consolidation of the goods as per summary packing lists. • Check marks and numbers on packages. Carry out the corrections, if necessary. • Label the packages linking to the proposed shipping carrier to ensure that package does not get left out. | ROD |

| | | | | |
|---|--|--|---|--|
|  | BELLARY 1 X 700 MW TPS | | SPECIFICATION NO. PE-TS-367-553-A001 | |
| | | | VOLUME II B | |
| | LIST OF MAKES AIR-CONDITIONING SYSTEM | | SECTION C | |
| | REV. | | DATE: 19.03.2012 | |
| | SHEET 1 of 3 | | | |
| <p>ANNEXURE-I</p> <p>LIST OF MAKES</p> | | | | |



SUB VENDOR LIST & INSPECTION CATEGORISATION
COMPRESSED AIR SYSTEM

| SL No | Item | QP / Insp.Cat | Proposed Subvendor | Place of Manufacturer | Remarks |
|-------|---|---------------|--|-----------------------|--|
| 1 | OIL FREE SCREW COMPRESSOR COMPLETE SKID MOUNTED WITH MOTOR, CONTROL PANEL AND ACCESSORIES | I | ATLAS COPCO - BELGIUM Assembly along with Indigenous components and Testing at Atlas Copco Works - Pune | Belgium (Pune) | |
| | | I | KOBELCO - JAPAN Assembly along with Indigenous components and Testing at KPCL Works - Pune | JAPAN (Pune) | |
| | | I | ELGI Air End from Hitachi Japan, Assembly along with Indigenous components and Testing at ELGI Works - Coimbatore | Coimbatore | |
| | | I | Ingersoll Rand Compressor from IR USA, Assembly along with Indigenous components and Testing at IR Works - Ahmedabad | Ahmedabad | |
| 2 | REFRIGERATED TYPE ADP | I | DELAIR | CHENNAI | |
| | | | SUMMITS | COIMBATORE | |
| | | | TRIDENT | COIMBATORE | |
| | | | GEM | COIMBATORE | |
| | | | ATLAS COPCO Testing at Atlas Copco Works - Pune | Belgium (Pune) | |
| 3 | MS/GI Pipes –ERW IS 1239 / IS 3589 (Quantity < 200 meters Assorted sizes) | III | SAIL | Rourkela | Material will be accepted on the basis of Main contractor COC supported by manufacturer TC as per relevant Code. In addition to above main contractor will certify availability of correlated identification marks on pipe wrt Manf TC and will also certify that pipes are free from rust |
| | | | Jindal (upto 350NB) | Ghaziabad | |
| | | | Surya Roshni (upto 400NB) | Bahadurgarh | |
| | | | Tata (upto 150NB) IS 1239 Pipes | Jamshedpur | |
| | | | Maharashtra seamless (200 to 500 NB) IS 3589 | Raigad | |
| 4 | Forged/Formed fittings | III | EBY | TALOJA | |
| | | | Siddarth & Gautam | FARIDABAD | |
| | | | Pipefit | BARODA | |
| | | | MS Fittings | KOLKATA | |
| | | | Tube Products | BARODA | |
| | | | Bharat Forge | PUNE | |
| 5 | Ball Valve | I | NL Hazra | KOLKATA | |
| | | | Precision Engg | Nasik | upto 400NB 150 class |
| | | | Microfinish Valves Ltd | Hubli | upto 50NB 800 class; 400 NB 300 class |
| | | | BDK engg Industries | Hubli | upto 50NB 800 class ; 400NB 150 class |
| | | | Flow chem. Industries | Ahemdabad | upto 50 NB 800 Class: 350NB 150 class |
| | | | Audco | Chennai | |
| | | | Akay India | Hubli | upto 50NB 800 class |

| SL No | Item | QP / Insp.Cat | Proposed Subvendor | Place of Manufacturer | Remarks |
|-------|---|---------------|--------------------------|-----------------------|--|
| 6 | CS/FS Gate/Globe/Check valves Upto 600 NB 150 Class, 50 NB 800 Class | III | Fouress | Mumbai/Aurangabad | |
| | | | BDK | Hubli | |
| | | | Audco | Chennai | |
| | | | Leader | Jullundhar | |
| | | | KSB | Coimbatore | |
| | | | KBL | Kondhapuri | |
| 7 | Butterfly Valve (Upto 500 NB PN 16) | II | KBL | Kondhapuri | |
| | | | Fouress | Bangalore | |
| | | | Audco | Chennai | |
| | | | BDK | Hubli | |
| | | | Tyco | Halol | |
| | | | Inter Valve | Pune | |
| 8 | Air Receiver | I | Integrated Engineers | Mumbai | |
| | | | Diamond Fabricators | Pune | |
| | | | Parkaire | Delhi | |
| | | | Temasme Vesselex | Noida | |
| | | | United Engineering Works | Nasik | |
| 9 | Safety Relief Valve | III | LEADER | JALANDHAR | |
| | | | SPIRAX MARSHALL | PUNE | |
| | | | FISCHER SANMAR | CHENNAI | |
| 10 | Pr./Vacuum/Dp Gauges | III | Auxitrol | U.K | |
| | | | Switzer (for DP gauge) | Chennai | |
| | | | Budenburg | U.K | |
| | | | A.N.Instruments | Kolkata | |
| | | | Bells Control | Kolkata | |
| | | | Manometer India | Mumbai | |
| | | | H Guru | Muzzafarpur / Risra | |
| | | | General Inst. | Mumbai/Goa | |
| | | | Gluck India | Mumbai | |
| 11 | Pr./Vacuum/DP.switch | II* | Indfos Ind. | Ghazibad | * If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted |
| | | III | Barton Inst.system | USA | |
| | | I* | Gauges Bourdon | Mumbai | |
| | | II* | Switzer | Chennai | |
| | | | Budenburg | U.K | |
| 12 | Temperature Gauge | III | A.N.Instruments | Kolkata | |
| | | | Bells Control | Kolkata | |
| | | | H Guru | Muzzafarpur / Risra | |
| | | | General Inst. | Mumbai/Goa | |
| | | | | | |
| 13 | Temperature Transmitter | I | (ABB) | Faridabad/Germany | For Din Rail Type only |
| | | II* | Yokogawa | Japan | * If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted |
| | | II* | Emerson (Rosemount) | USA | |

| SL No | Item | QP / Insp.Cat | Proposed Subvendor | Place of Manufacturer | Remarks |
|-------|-----------------------------|---------------|----------------------------------|-----------------------|--|
| 14 | Pr./DP Transmitter | I | (ABB) -2600T series | Faridabad/Italy | |
| | | II* | Honeywell | USA/India | * If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted |
| | | III | Fuji | Japan | |
| | | III | Emerson (Rosemount) | USA | |
| | | II* | Emerson (Rosemount) | Daman | |
| | | II* | Yokogawa | Japan | Calibration at YIL Bangalore is acceptable |
| 15 | HT Motor for Air compressor | I | CGL | Mandideep | Upto 1600 KW, 6.6 KV; Upto 1310 KW, 11 KV |
| | | | Marathon Electric | Kolkata | Upto 6.6 KV, 750 KW |
| | | | BHEL | Bhopal | |
| 16 | Flow Switch | III | Switzer | Chennai | |
| | | | Levecon | Kolkata | |
| | | | DK Instruments | Kolkata | |
| | | | Delta | UK | |
| | | | ITT Barton | USA | |
| 17 | Temp Sensor | III | Pyro Electric | Mumbai | |
| | | | Detriv | Mumbai | |
| 18 | Flow Indicator | III | Sigma | Mumbai | |
| | | | Eureca | Pune | |
| 19 | Auto Drain Trap | III | Main Contractor approved sources | | |
| 20 | Dew point meter | III | GE Sensing | Ireland | |
| | | | Michell Instruments | UK | |
| | | | Shaw | UK | |
| 21 | Flow Meter / Rota Meter | III | Trac | Hyderabad | |
| | | | Eureca | Pune | |
| 22 | Level Indicator/ Gauge | III | Sigma | Mumbai | |
| | | | Levcon | Kolkata | |
| | | | Pune Techtrol | Pune | |
| | | | SBEM | Pune | |
| 23 | Solenoid Valve | III | HERION | GERMANY/ ITALY | |
| | | | ROTEX AUTOMATION LTD. | V V NAGAR/ BARODA | |
| | | | ASCO | CHENNAI | |
| | | | JEFFERSON | ARGENTINA | |
| | | | AVCON | MUMBAI | |
| 24 | Cable Glands | III | SUNIL& COMPANY | KOLKATA | |
| | | | ARUP ENGG | KOLKATA | |
| | | | COMMET | MUMBAI | |
| | | | QUALITY PRECISION | KOLKATA | |
| 25 | Cable Lugs | III | DOWELLS | MUMBAI | |
| | | | CHETNA ENGG | NASIK | |
| | | | 3D | VALSAD | |

296

| SL No | Item | QP / Insp.Cat | Proposed Subvender | Place of Manufacturer | Remarks |
|-------|--------------|---------------|------------------------------------|-----------------------|---------|
| 26 | Junction Box | III | Main Contractor Approved Sources | | |
| 27 | PLC | I | ABB | BANGALORE | |
| | | | ROCKWELL AUTOMATION (ALLEN BRADLY) | SAHIBABAD | |
| | | | Siemens | Mumbai | |
| | | | GE FANUC | BANGALORE | |
| | | | L&T | Mumbai | |
| | | | Group Schneider | | |

NOTE :

- 1) INSP CAT I : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED AND FINAL ACCEPTANCE WILL BE ON PHYSICAL INSPECTION WITNESS BY BHEL & Customer.
- 2) INSP CAT II : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED. HOWEVER NO PHYSICAL INSPECTION WILL BE DONE BY BHEL / Customer. THE FINAL ACCEPTANCE BY BHEL /Customer SHALL BE ON THE BASIS OF REVIEW OF DOCUMENTS AS PER QP.
- 3) INSP CAT III : FOR THOSE ITEMS FINAL ACCEPTANCE BY BHEL / Customer BASED ON BIDDER'S COC.



TECHNICAL SPECIFICATION
COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-210-555-A000

VOLUME II B

SECTION C

REV. 0

DATE: September 2003

SHEET

ANNEXURE - II
CODES & STANDARDS



TECHNICAL SPECIFICATION

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PES-555-02

VOLUME II B

SECTION C

REV. 0

DATE: September 2003

SHEET 1 OF 2

1. SCOPE

This specification covers the design, manufacture, inspection and testing at the manufacturer's and/or his sub-contractor's works and performance testing of the air compressors and associated accessories at site.

2. CODES & STANDARD

The design, manufacture, inspection testing and performance of the air compressors shall comply with all statutory, regulations and safety codes currently applicable in the locality where the equipment will be installed.

Nothing in this specification shall be construed to relieve the vendor of their responsibility. The equipment in general shall conform to the latest edition of the following standards:

- 2.1.1 IS:6206 Guide for selection, installation and maintenance and maintenance of air operating pressure up to 10 bars.
- 2.1.2 IS:2825 Code for unfired pressure vessels.
- 2.1.3 IS:5456 Code for practice for testing of positive displacement type air compressor and exhauster.
- 2.1.4 BS:1571 Performance test of compressors.
- 2.1.5 IS:5727 Glossary of term relating to compressors and exhausters.
- 2.1.6 IS:10431 Pt.1 Measurement of air flow of compressors and exhausters
- 2.1.7 BS:864 Compression and capillary tube fittings.
- 2.1.8 PTC 9 Power test codes for positive displacement compressors, vacuum pumps and blowers.
- 2.1.9 IS:2062 Structural steel (fusion welding quality).
- 2.1.10 IS:1239 Mild steel tube and fittings. (Part I & II)
- 2.1.11 BS:4504 Flanges and fittings for pipes, valves and fittings.
- 2.1.12 IS:1364 Precision and semi precision hexagone bolts, screws, nuts and lock nuts (dia 6 to 39 mm).
- 2.1.13 TEMA Thermal equipment manufacturer's associates.
- 2.1.14 ASME VIII Div. I Section Code for unfired pressure vessels
- 2.1.15 IS:2016 Plain washers
- 2.1.16 IS:1363 Black hexagonal bolts, nuts and locks and nuts (dia 6 to 29 mm)
- 2.1.17 IS 4503 Shell & Tube Type Heat Exchangers
- 2.1.18 IS:4009 Green nipples
- 2.1.19 IS:694 Specification for PVC insulated cables for voltages up to 110 V. Part - I
- 2.1.20 BS: 4368 Compression couplings for tubes steel.
- 2.1.21 BS: 4579 Compression joints for cables and wires.
- 2.1.22 ANSI: B 16.5 Steel pipe flanges and flanged fittings.
- 2.1.23 IS:1875 Carbon steel billets, blooms slabs and bars for forging



TECHNICAL SPECIFICATION
COMPRESSED AIR SYSTEM

SPECIFICATION NO. PES-555-02

VOLUME II B

SECTION C

REV. 0

DATE: September 2003

SHEET 2 OF 2

| | | |
|--------|----------|---|
| 2.1.24 | IS:210 | Grey iron castings |
| 2.1.25 | API: 618 | Reciprocating compressors for general refinery services |
| 2.1.26 | IS 8935 | Electric Solenoid Operated Actuators |

300

PEM-6666-0



TITLE

**COMPRESSED AIR SYSTEM
MARIB GTPS 400 MW**

SPECIFICATION NO. PE-TS-372-555-A001

VOLUME

SECTION

REV 00

DATE 20/07/2012

SHEET

SECTION - D

STANDARD TECHNICAL SPECIFICATIONS



TITLE:

COMPRESSED AIR SYSTEM

**STANDARD TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-TS-888-555-A001

VOLUME - IIB

SECTION-D



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

302



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 1 OF 15

INDEX

| | |
|---|----|
| 1. GENERAL..... | 2 |
| 2. SYSTEM DESCRIPTION | 2 |
| 3. DESIGN CRITERIA | 2 |
| 4. OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS..... | 3 |
| 5. RECIPROCATING OIL FREE COMPRESSOR | 6 |
| 6. AIR RECEIVERS..... | 10 |
| 7. AIR DRYING PLANTS..... | 11 |
| 8. INTER CONNECTING PIPING, FITTING AND VALVES..... | 13 |
| 9. INSTRUMENTATION (GENERAL)..... | 14 |



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 2 OF 15

1. GENERAL


- 1.1 This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the compressed air system, as specified hereinafter.

2. SYSTEM DESCRIPTION

- 2.1 The compressed air system shall consist of instrument air compressors & air drying plant (ADP), plant air compressors, air receivers, control panels interconnecting compressed air piping, cooling water piping, instrumentation and control.
- 2.2 The compressors shall be arranged such that all the plant air compressors shall supply air to the upstream (header of instrumentation air of each ADP through an isolation and a non-return valve so that in the event of failure of instrument air compressor, the instrument are in ensured at all time continuously.

3. DESIGN CRITERIA

- 3.1 The instrument air compressor will be designed to meet the instrument air requirements of all the equipments /plants/systems as specified elsewhere in the specification (excluding the compressed air requirement of Ash Handling Plant).
- 3.2 The Plant/Service air compressor will be designed to meet the plant/service air requirements of all the equipments / plants / systems as specified elsewhere in the specification (excluding the plant air requirement of Ash Handling Plant) or capacity be identical as that of the instrument air compressors whichever is higher.
- 3.3 Design margin of 25% is to be considered for IA & PA/SA requirement for sizing of the Instrument Air Compressor & Plant/Service Air Compressor.
- 3.4 Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.
- 3.5 The compressors' capacity will be designed for 45° C DBT and 75% RH
- 3.6 For Instrument Air, Delivery pressure will be 7.5 Kg/cm² (g) at ADP outlet.
- 3.7 For Plant / Service Air, Delivery pressure will be 8.0 Kg/cm² (g) at Compressor outlet.
- 3.8 Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.
- 3.9 The continuous motor rating (at 50° C ambient) will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.
- 3.10 Velocity of air in the air piping shall be limited from 6 to 9 m/sec.
- 3.11 Velocity of water flow shall be limited to 2.5 m/sec and for gravity flow the same shall be limited to 1.5 m/sec.
- 3.12 For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.

| | | | |
|---|--|--|-----------------------|
|  | TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM | SPECIFICATION NO. PE-SS-EPC-555-A-001 | |
| | | VOLUME II B | |
| | | SECTION D | SUB-SECTION A8 |
| | | REV. 0 | |
| | | SHEET 3 OF 15 | |

| | |
|-------|---|
| 3.13 | Noise level of compressors not to exceed 85 dBA to a reference of 0.0002 microbar when measured at a distance of 1.5 m above the floor in elevation and at a distance of 1 m horizontally from the nearest surface of compressor. |
| 3.14 | Compressors to be designed for Continuous, Load-Unload and On-Off mode operation. |
| 3.15 | Satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, noise etc. |
| 4. | OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS |
| 4.1 | AIR COMPRESSOR SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS. |
| 4.1.1 | Design / Construction |
| | i) Compression chamber Wall thickness to withstand maximum design pressure. |
| | ii) Casing with a large inlet port for fast filling and low air velocity. |
| | iii) To provide suitable arrangement for cleaning of the cooling water jackets during maintenance of compressor. |
| | iv) Dynamically balanced, one piece Rotors with asymmetric profile, to keep leakage losses to a minimum and ensure high efficiency. |
| | v) Rotor shaft mounted, oil lubricated, highly precise timing gear shall be designed to counter act the axial forces incurred in compression. |
| | vi) Life of Oil lubricated anti-friction type bearing be at least 8000 running hours. |
| | vii) Shaft Seals of floating restrictive ring type design. |
| | viii) The shaft seal rings and retainers shall be free for radial self-adjustment on the rotor shafts. |
| | ix) Minimum design service factor for the integral, oil lubricated type, step-up Gear Box shall be of 1.5. |
| | x) To provide safety valves on low pressure and high pressure stages. |
| | xi) A direct driven positive displacement type oil pump connection to the main drive shaft is preferred. Alternatively a separate motor driven oil pump be provided. |
| | xii) The lubrication system to include oil pump, oil filter, oil cooler and oil tank / sump. |
| | xiii) Cooling shall be by closed circuit Demineralised water. |
| | xiv) Compressor shall be directly coupled with constant speed squirrel cage induction motor conforming to the technical specification attached elsewhere. |
| 4.1.2 | Material of construction |
| | The materials of various components shall conform to the applicable BIS / BS / ASTM / DIN standard or any other reputed standards. |
| | i) Compressor chamber: Cast iron coated with corrosion resistant material. |
| | ii) Rotors: Forged carbon steel coated with corrosion resistant material |

305



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 4 OF 15

- | | |
|---|-------------------------------------|
| iii) Timing Gear: | Low, Alloy Steel. |
| iv) Inlet throttle valve & Housing: | Aluminium |
| v) Shaft Seals: | High, Alloy Steel. |
| vi) Safety valves: | Brass |
| vii) Water separator: | Cast Iron |
| viii) Non-return valves: | Stainless steel spring loaded type. |
| ix) Blow off valve: | Stainless steel. |
| x) Unloading Cylinder header: | Aluminium |
| xi) Tube of Blow off cooler / oil cooler: | SS 304 |
| xii) Outer casing of coolers: | Carbon Steel |
| xiii) Gear box: | Cast Iron |
| xiv) Gears: | Alloy Steel. |

However, Material of Construction of components of Screw Compressor of reputed manufacturer shall also be acceptable subject to BHEL/Customer's approval.

4.1.3

Accessories

Each compressor skid to include Suction filter, silencer, intercooler & After cooler with moisture separators, automatic drain traps, instruments, control panel Base plate, coupling guard. Foundation bolt, nuts, anti vibration pads, Eye bolts and operation and maintenance tools.

4.1.4


Control Philosophy

- i. Each compressor be operatable under continuous, auto, "Load-Unload" or "On-Off" mode (i.e.) "Dual control modes".
- ii. Any of the compressors shall be selectable at control panel to operate either for Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) operation.
- iii. In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall:
 - a) Operate the load-unload circuit at a predetermined set pressure.
 - b) Throttle the inlet valve.
 - c) Open the blow off valve.

Unloaded compressors to run in idling mode and when system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow-off valve.

- iv. In "Stand-by" duty the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor shall be started to unloaded condition. After a suitable time delay, the compressor shall be fully loaded.
- v. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period, (set by a timer), the compressor may be loaded to; full load in case of drop in system

306

| | | | |
|---|--|--|-----------------------|
|  | TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM | SPECIFICATION NO. PE-SS-EPC-555-A-001 | |
| | | VOLUME II B | |
| | | SECTION D | SUB-SECTION A8 |
| | | REV. 0 | |
| | | SHEET 5 OF 15 | |

pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.

vi. The pressure and duration of time to be set shall be adjustable at site from the panel.

vii. Further all interlocks for safe and proper operation of the compressors shall be provided by the Bidder.

viii. All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.

ix. Independent switches shall be used for alarms (annunciations) and tripping or interlock as far as possible.

x. An electrically operated automatic valve shall be provided on cooling water supply line of each compressor which will automatically shut off the cooling water supply, in case compressor is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of the compressor.

4.2 Intake Filter and Silencer

Intake Air Filter and Silencer shall be comply with the following requirements:

4.2.1 Performance

i. Filtering efficiency minimum 99% down to 10 microns.

ii. Maximum pressure drop across filter at design flow rate in new condition be 250 mm of water column.

iii. Design Airflow rate corresponding to compressor airflow.

4.2.2 Quantity: One per compressor

4.2.3 Design air data

i. Dust concentration: 30 mg / M³

ii. Particle size in microns: Up to 10 microns

4.2.4 Type/Design: Heavy duty type

4.2.5 Construction

i. To provide densely packed, replaceable type paper as filtering media.

ii. Filter to be designed to have sound suppressing characteristics.

iii. Preferably Filter and silencer be combined type.

iv. Filter to take suction from outside not from compressor room.

4.3 Inter Cooler & After Cooler

Inter cooler and After cooler shall comply with the following requirements:

4.3.1 Performance

i. Outlet temperature of air from intercooler to suit the equipment offered.

ii. Outlet temperature of air After cooler to be limited to 10 Deg.C of inlet cooling water temperature.

4.3.2 Type: Shell and tube type

4.3.3 Construction

i. Design code: TEMA class "C" or equivalent.

307

307



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 6 OF 15

- ii. With removable tube bundle type.
- iii. With internal baffling.
- iv. Design pressure in airside: 2 Kg / Cm² more than air inlet pressure.
- v. Design pressure in waterside: Not less than shut off head of DM cooling water pump.

4.3.4

Material

- i. Tube : Admiralty brass or Aluminium brass or SS 304.
- ii. Shell : SA 285 Gr.C or equivalent
- iii. Tube sheet: SA 285 Gr.C or equivalent
- iv. Baffle : Carbon steel
- v. Flanges : Steel IS 2862.

4.3.5

Accessories

- i. To provide necessary vent & drain connections.
- ii. Moisture separation units with level gauge.
- iii. Automatic drain trap stations with bypass & isolating valves for moisture separators.
- iv. Safety valves
- v. Lifting eye bolts, tools & tackles if any.

4.3.6

Additional Data

After coolers are not to be fitted with instrument air compressors if bidder offers "Heat of compression" type air drying plants and the same shall be provided at down stream of ADP.

5.

RECIPROCATING OIL FREE COMPRESSOR

5.1

Each of the Compressors shall comprise but not be limited to the following:

5.1.1

LP and HP cylinders as required to meet the compressor rating, intercoolers, automatic drain trap station, relief valves and other accessories.

5.1.2

Drive machinery including drive motor and accessories.

5.1.3

Frame lubrication system, complete with protective devices and instruments.

5.1.4

After cooler and moisture separator both complete with automatic trap station, relief valves and other accessories and instruments .

5.1.5

Air intake filter and silencer unit

5.1.6

Set of local instruments as applicable

5.1.7

Set of cooling water control valves.

5.1.8

Set of foundation bolts, nuts etc. for compressors, motors, after coolers, suction filters etc.

5.1.9

Control panel comprising of all relays, contactors, solenoid valves, pressure switches, instruments, pneumatic impulse air tubing annunciation window selector switches etc.

5.1.10

Flow indicator of jacket cooling water after the inter and after coolers

5.1.11

Relief valves on the instrument and service air headers and also after the interconnection header between SA and IA headers.

308



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 8 OF 15

5.2

CONSTRUCTION FEATURES

5.2.1

Air Compressors

- i. Each compressor shall be multi stage, reciprocating, water cooled type. Compressor cylinder shall be closed grained cast Iron conforming to IS:210 FG 260 or equivalent. The cylinder shall be provided with renewable liners or recording allowance as per API-015, 1974. The crankshaft and connecting rods shall be of forged steel conforming to IS:1875 or equivalent and statically and dynamically balanced. The service air compressors shall be lubricated / non lubricated type (as required in the data sheet A) whereas the instrument air compressors shall essentially be non lubricated type and the air delivered by these instrument air compressors shall be completely free of any oil, grease and other impurities. To ensure, this the piston rings shall be of Teflon and no lubricating oil shall be used in the cylinder. Special care shall be taken to prevent any oil from finding its way into the cylinders from the crank case.
- ii. The piston rod packing shall also be of oil less self lubricating type. Any oil adhering to the piston rod shall be wiped off by suitable water rings. Suitable collar may also be fixed in the piston rod so that any trickling oil flow can be stopped from movement towards the cylinder.
- iii. The intake filters with built in silencers shall be of dry reusable type located at the air intake connection to low pressure cylinder to remove any carried solid particles in air.
- iv. Crank case shall be of rugged construction and shall have openings for access to all crank case machinery. A level indicator shall be provided for all crank case oil sump.
- v. Each compressor shall be driven preferably by direct coupled electric motors or otherwise through 'V' belt drives. The drive shall be provided with a safety guard.
- vi. Flywheels shall be provided, if required, and shall be of adequate size to smoothen the effect of fluctuation of turning moment load during crank revolution.
- vii. Compressor valves shall have large effective areas permitting low velocities. In case of on lubricating type compressors, valves disc. Shall be either of stainless steel to AISI 316 or 15% chrome steel heat treated, tempered and ground. The valve seats and guards shall be case hardens and valve spring shall be of stainless steel. Self lubricating valve guides and wear strips shall be used for noiseless operation and long life. The tenderer shall offer his standard materials of construction for the valve for lubricated type of compressor.
- viii. To shut off cooling water flow through intercooler, compressor jacket and after coolers, operate lockable type gate valve (lockable in open position) shall be provided. These valves are to be shut off manually when required.
- ix. The crankshaft bearings shall be of antifricition type. A crankshaft driven positive displacement pump shall draw lubricating oil from the crankcase sump though a strained and shall provide for forced lubrication to all the bearings.
- x. The compressor lube oil pressure shall be built up with in a predetermined time (adjusted by a timer) failing which the compressor shall automatically trip.
- xi. Provision shall be made for lubricating the parts where ever necessary to ensure smooth operation and freedom from undue wear.
- xii. Gear boxes and oil bath shall be provided with filling and drain plug of adequate size and shall also be provided with visual level indicators. Provision shall be made for efficient lubrication of all bearings, including ball and roller bearings by the use of separate grease cups, self sealing nipples of oil baths. Housing of

3/10



TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM

| | |
|---------------------------------------|----------------|
| SPECIFICATION NO. PE-SS-EPC-555-A-001 | |
| VOLUME II B | |
| SECTION D | SUB-SECTION A8 |
| REV. 0 | |
| SHEET 9 OF 15 | |

ball and roller bearings shall be packed at the time of assembly. Necessary provision shall be made for preventing dust ingress into lubricated parts. A drawing showing all lubricant points and recommended lubrications to be used shall be supplied. The first fill of oil lubricant of correct grade shall be provided.

- xiii. All lubrication systems fittings on all equipment supplied shall wherever possible be standardised. The grease nipples shall be of button head type or approved equal and shall conform to IS:4009.
- xiv. The power ratings of the driver shall be selected such that the minimum margin of 15% is available over the power requirement to deliver rated capacity at rated pressure. When the drive is not directly coupled to the compressor, due account should be made for losses in power transmission in addition to the above margin. In case belt driven compressors, 5% belt loss should be considered over and above 15% spare margin in selecting the driven motor.

5.2.2

Inter Cooler, After Cooler and Moisture Separator

- i. The intercooler shall be provided between the low and high pressure stages of the compressor. The after coolers and moisture separator shall be located between the compressor discharge and air receiver. Volume bottles shall be provided at LP cylinder discharge end and HP cylinder suction and discharge ends to take care of the pulsation or air flow. Both intercooler and after cooler shall be water cooled complete with standard accessories, such as safety valves moisture separator and automatic drain trap, bypass arrangement for automatic drain trap. The equipment shall be complete with the instrument mentioned elsewhere in this specification included in the scope of work. The inter cooler and after cooler shall be designed with adequate margin in heat transfer area. For design purpose a cleanliness factor of 0.85 shall be used in both cases.
- ii. The after cooler shall be designed such that the temperature of air leaving is not more than 80 deg. C above the cooling water inlet temperature.
- iii. Following material of construction shall be used.
 - a) Shell: ASTM A-285 Gr. C or approved / Equal
 - b) Tubes: Copper as per BS-378 or admiralty brass to ASTM B-111 type B.
 - c) Moisture separator: Galvanised, to prevent corrosion Internal.
- iv. The lower portion of moisture separator shall be provided with the gauge glass. Pressure drop in intercooler, after-cooler & moisture separator, shall be kept to a minimum. Pressure parts shall be designed as per IS:2825 or as per ASME section VIII Div. 1 Design of coolers shall be as per TEMA class C.
- v. Both intercooler and after cooler shall preferably be standardised in regard to tube material, tube outside diameter & tube length.

5.2.3

Oil Separator

- i. In case compressed air is to be fed from the lubricated compressors to the pneumatic/control valves, then it would be desirable that the air is made oil free before it is fed to the pneumatic valves bypassing it through and air separator. (Please refer to data sheet A).
- ii. The oil separator shall be constructed from carbon steel in accordance with pressure vessel codes like ASME Section VIII Div. 1 or IS 2525. The design pressure of this same shall be indicated in Data Sheet A. The oil separator shall be able to remove the oil in the condensed form by impingement on a cartridge of synthetic wool to a degree as specified in Data Sheet A.
- iii. The design of the oil separator shall be such as to facilitate easy removal of the synthetic wool cartridge for cleaning. A drain valve shall also be provided.

811



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8

REV. 0

SHEET 10 OF 15

- iv. The frequency at which the oil separator is to be drained and the time after which the synthetic wool should be either washed with a solvent or replaced shall be clearly indicated.

5.3 Control and Interlock Equipment

5.3.1 Compressor Capacity Control

- i. Control system for each compressor shall be to maintain receiver pressure within the specified limits by load unload Control" or on-off control" (i.e. dual control as per data sheet 'A' which are briefly described below:-
- ii. The loading/unloading of the compressor is to be actuated through pressure switches located on the outlet header of each compressor. The compressor(s), in this mode of control would run continuously at constant speed but would be loaded and unloaded in steps of 100, 50% and 0% by closing and opening of the respective suction valves. This is to be achieved by means of a selector switch, having two position viz "Auto" and 'Mechanical'.
- iii. In the auto position the control will be through electro pneumatic means i.e. pressure switches while in the mechanical position, the control shall be through adjustable spring loaded mechanical governors.
- iv. Normally the selector switch for control for all the compressors will be in the 'Auto' position and the mechanical position is only a standby arrangement.
- v. Another selector switch is to be provided for selecting the duty of the compressor viz. 'Main' or 'Standby' Duty. Depending upon the position selected in this selector switch, the compressor will run as a main compressor or be a standby.
- vi. In the ON-OFF mode of capacity control the compressor will always be loaded except during starting. The compressor is started automatically when the discharge header pressure falls below the set value by the pressure switch. The compressor is stopped when the discharge header pressure reaches upper set limit on another pressure switch. The first start of compressor will however, be manual. In the event of tripping of compressor on fault or manually, the compressor will not start automatically until the fault is reset and started manually.

5.3.2 COMPRESSOR PROTECTION


The control panel shall house an audio visual alarm system for each compressor in order to ensure safe operation of the compressors and to bring their abnormal operation to the notice of the operator. The items to be annunciated for IA & SA compressors shall include but not be limited to the following:-

- a) Receiver pressure high alarm
- b) Receiver pressure very high trip
- c) Receiver pressure low alarm
- d) Compressor lube oil pressure low alarm
- e) Compressor lube oil pressure very low trip
- f) Air temperature after aftercooler high alarm
- g) Air temperature after after-cooler very high trip
- h) Compressor cylinder water outlet temperature high alarm
- i) Compressor cylinder water outlet temperature very high trip.

6. AIR RECEIVERS

Air receivers shall comply with the following requirements.

312

| | | | |
|---|--|--|-----------------------|
|  | TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM | SPECIFICATION NO. PE-SS-EPC-555-A-001 | |
| | | VOLUME II B | |
| | | SECTION D | SUB-SECTION A8 |
| | | REV. 0 | |
| | | SHEET 11 OF 15 | |

6.1.1

Design

- i. Design pressure & temperature : 10 Kg/cm² & 50 Deg.C.
- ii. Outdoor located, vertical cylindrical vessel.
- iii. Design code : ASME Sec. VIII Div 1 or IS:2825 & IS 7938.
- iv. Welded Construction : Longitudinal seam in adjacent sections shall not be in same line.
- v. To provide gasketed inspection manhole of minimum 500 diameter.
Opening shall not pierce any seam & shall be as far as possible away from any welded seam.

6.1.2

Fabrication

- i. Welding as per relevant codes.
- ii. Filler material to have composition & structure as that of material welded.
- iii. Welding electrodes to be approved by Owner.
- iv. Electrodes to be dried before use.

6.1.3

Accessories

- i. To provide Relief valves to suit compressor capacity and set pressure of the same at least 10% above working pressure.
- ii. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.
- iii. Drain connection with automatic trap stations.

6.1.4

Material

Shell End plates & flanges — IS:2002 or Equivalent.

7.

AIR DRYING PLANTS

Air Drying plants shall comply with the following requirements:

7.1

Performance Requirements

- 7.1.1 Normal flow rate: To match compressor capacity.
- 7.1.2 To be designed for continuous duty for dew point of outlet air at minus (-) 40 Deg.C at atmospheric pressure.
- 7.1.3 Quality of dry outlet air to conform to Instrument society of American standard S7.3 "Quality Standard for Instrument Air".
- 7.1.4 ADP to be placed upstream of the air receiver.

7.2

Quantity

- 7.2.1 One ADP for each Instrument air compressor.

7.3

Type / Design

- 7.3.1 "Heat of Compression type ADP" either "Conventional Type" or "Rotary Drum type".
- 7.3.2 Drying by absorption method.

313



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B


SECTION D SUB-SECTION A8

REV. 0

SHEET 12 OF 15

- 7.4 Construction of Conventional heat of Compression type ADP**
- 7.4.1 Reactivation shall be by "Heat of Compression" method without any air purge loss. Hot unsaturated compressed air shall be used for regeneration of exhausted dessicant in case of "Heat of compression type ADP".
- 7.4.2 With two absorber tower per ADP for conventional type (One for drying while the other is under regeneration / standby modes).
- 7.4.3 Design drying cycle: 8 Hours.
- 7.4.4 Design regeneration cycle: Less than 8 hours including cooling period.
- 7.4.5 Indoor located.
- 7.4.6 With (minimum) 3 steps de-pressurisation.
- 7.4.7 To provide automatic tower change over control with provision for manual take over.
- 7.4.8 All pressure vessels to be designed as per IS:2825 or equivalent code.
- 7.4.9 All vessels to include required manholes / harid holes.
- 7.4.10 All hot vessels & pipelines to be insulated to restrict the outside temperature within 60 Deg.C with mineral wool (or equivalent), GI wire netting and aluminium cladding / over.
- 7.4.11 Quantity of dessicant to be calculated taking into account residual moisture content at the end of regeneration cycle. Design calculation with curves shall be submitted for approval of Owner.
- 7.4.12 Absorption capacity and density to be considered for silica gel shall not be more than 10% and 550 Kg/M³ respectively. In case of activated alumina the same shall be 8% (max) and 900 Kg/M³ (max.) respectively.
- 7.4.13 Minimum 20% of dessicant depth shall be provided as free board in adsorber vessels.
- 7.4.14 Adsorber vessels to be provided with suitable number of inspection / sight windows of peresplex for observation of adsorbent condition.
- 7.4.15 Dessicant filling and removal connection shall be provided.
- 7.4.16 Non-lubricated two way three way / four way valves ball valves with pneumatic actuators be provided.
- 7.4.17 In case of Heat of compression type adsorbers shall be sized so that even when the compressor is operating at 50% capacity, complete regeneration shall be achieved within the cycle time.
- 7.4.18 Complete ADP equipments shall be preferably mounted on a skid.
- 7.4.19 Required sample connections in piping be provided for sampling of air at desired locations.
- 7.5 Accessories**
- 7.5.1 Prefilters and After filters: 2x100% with automatic drain trap filter arrangement & with ceramic candle type elements.
- 7.5.2 Electric Heaters: 2x100% with thermostatic control for heater & facility for easy replacement of element.
- 7.5.3 To provide suitable solenoid valves for depressurisation and re pressurisation of towers.
- 7.6 Material**
- 7.6.1 Absorber vessels & its internals: MS Vessels as per IS; 2062 & Internals SS 304

314

| | | | |
|---|--|--|-----------------------|
|  | TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM | SPECIFICATION NO. PE-SS-EPC-555-A-001 | |
| | | VOLUME II B | |
| | | SECTION D | SUB-SECTION A8 |
| | | REV. 0 | |
| | | SHEET 13 OF 15 | |

| | | | |
|-------|---|--|--|
| 7.6.2 | Regeneration air cooler shell tube(if applicable): SA-285 Gr.C or equivalent | | |
| 7.6.3 | Blower casing: | Carbon steel | |
| 7.6.4 | Blower blades & shaft: | Stainless steel | |
| 7.6.5 | Relief valves: | Brass or SS | |
| 7.6.6 | Tube of heat exchangers and Dehumidifier: | Aluminium brass or SS | |
| 7.6.7 | Shell & tube sheet for the above: | SA 285 Gr.C. | |
| 7.6.8 | Baffle: | Carbon steel | |
| 7.6.9 | Dessicant: | Silica gel / Activated Aluminium or as per manufacture's standard. | |
| 7.7 | Control philosophy | | |
| 7.7.1 | Sequential operation of the adsorber towers be controlled automatically with a provision for manual take over. | | |
| 7.7.2 | Automatic operation of adsorber tower under drying, operation of the other tower under regeneration, change over of towers, starting and stopping of blowers, slow depressurisation & re pressurisation of towers etc. shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps. | | |
| 8. | INTER CONNECTING PIPING, FITTING AND VALVES | | |
| | Inter connecting piping, fittings and valves shall confirm to the following requirements. | | |

315



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D

SUB-SECTION A8


REV. 0

SHEET 14 OF 15

- 8.1 All interconnecting compressed air piping shall conform to IS: 1239 (Heavy Grade) or IS: 3589 Gr. 410 and galvanised as per IS : 4736.
- 8.2 Fittings for air piping shall be conforming to IS: 1239/IS:1879 and Grade equivalent that of parent pipe Grade.
- 8.3 Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60deg.C. The pipe joints will be screwed coupling type for sizes upto 50 NB and above 50 NB the same will be flanged.
- 8.4 All cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade).
- 8.5 For Air line Ball Valves with Stainless Steel internals with Teflon seat shall be provided. Ball valves upto 50 NB shall be of Forged Carbon Steel Body with screwed connections. Ball valves above 50 NB shall be of Cast Carbon Steel Body with flanged connections.
- 8.6 The check valves shall conform to IS: 3412.
- 8.7 For water line Gate valves shall be provided. For size 50 NB and smaller carrying water the same shall conform to IS:778 with gun metal body and trim and for above 50 NB with carbon steel body and internals.
- 9. INSTRUMENTATION (GENERAL)**
- 9.1 Detailed specification for the Instrumentation shall be referred in the control and instrumentation section of this volume.
- 9.2 The bidder shall include instruments / controls to facilitate safe, reliable and efficient operation for the system offered. The instrumentation control system offered by the bidder shall be subjected to approval of the Employer during detailed engineering.
- 9.3 All Instrumentation and Control equipments required for Compressed air system such as primary and secondary instruments, control panels / cabinets, cable etc. shall meet the requirements specified in control and instrumentation section of the Volume.
- 9.4 The protection and interlock system shall be subject to the approval of the Employer.
- 9.5 All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.
- 9.6 Following general philosophy shall be followed regarding instrumentation.
- 9.6.1 Pressure Indicators / Vacuum gauge:
- At inlet outlet of each compression stage (air line).
 - At inlet and outlet of cooling water header.
 - At inlet and outlet of (air line) each heat exchangers of compressors & air drying plant (in air side).
 - At inlet and outlet of each adsorber vessel.
 - At each air receiver and at outlet header of compressor & air drying plant.
 - At inlet of each of the filters of compressors assembly and ADP system.

316

7

| | | | |
|---|--|--|-----------------------|
|  | TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM | SPECIFICATION NO. PE-SS-EPC-555-A-001 | |
| | | VOLUME II B | |
| | | SECTION D | SUB-SECTION A8 |
| | | REV. 0 | |
| | | SHEET 15 OF 15 | |

9.6.2

Pressure Switches (Individual for each function).

i.

At inlet/outlet of each compressor stage of the compressor (for annunciation / interlock).

ii.

At each air receiver for:

a)

High/Low pressure alarm, for start/stop control.

b)

For load/unload control.

c)

At common discharge outlet of compressor & air drying plant (for alarm)

iii.

At discharge of each compressor.

9.6.3

Temperature Indicators

i.

At inlet and outlet of each heat exchangers / coolers of compressor and air-drying plant in the lube oil, air & cooling water circuits.

ii.

At inlet and outlet of electric heaters & exhaust (atmosphere) of regeneration air (for open through type ADP).

iii.

At inlet and outlet of each adsorber vessel.

iv.

At common discharge outlet of compressor & ADP.

9.6.4

Temperature Switches / Temperature Controllers

i.

At inlet and outlet of each heat exchangers / coolers of compressor and air drying plant in the air & cooling water and lube oil circuits for low & high alarms, trip & interlock.

ii.

At outlet of electric heaters & exhaust of regeneration air (open through type ADP) for alarm & interlock.

iii.

At discharge of each compressors (before air receiver).

iv.

At common discharge outlet of air compressors & air-drying plant.

317

317

400MW MARIB GAS TURBINE POWER STATION (PHASE - II)**COMPRESSED AIR SYSTEM
SUGGESTIVE PRICE FORMAT**

| Clause No. | DESCRIPTION | Qty. | Unit | Unit Price (Rs) | Total Price (Rs) |
|------------|--|------|------|-----------------|------------------|
| 1 | LUMPSUM PRICES Total lumpsum firm prices for Equipment & Services as Specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, preparation and submission of as built drawing for the total scope of Compressed Air System as per Specification No. PE-TS-372-555-A001 including supply of erection materials, consumables as required to complete the compressed air plants/equipments installation, maintenance tools & tackles, consumables and first fill of consumables, all taxes, duties but excluding recommended spares & optional items etc. | 1 | Lot | | |
| 2 | Break up prices for items covered in clause 1.0 above. Prices for design, manufacture, inspection & testing at manufacturers works & supply of following items. | | | | |
| 2.1 | Instrument Air Compressor (oil free Screw / Rotary Tooth type) Each of minimum 6 NM ³ /Min capacity at 8.0 kg/cm ² (g) consisting Electric motor to drive the compressor with accessories, Suction filter and silencer, Inter Cooler, After Cooler (as applicable) with moisture separators, automatic drain traps, instruments, Control panel etc. | 2 | Nos | | |
| 2.2 | Service Air Compressor (oil free Screw / Rotary Tooth type) Each of minimum 6 NM ³ /Min capacity at 8.0 kg/cm ² (g) consisting Electric motor to drive the compressor with accessories, Suction filter and silencer, Inter Cooler, After Cooler (as applicable) with moisture separators, automatic drain traps, instruments, Control panel etc. | 2 | Nos | | |
| 2.3 | Air Dryer Air cooled refrigerant type Air Dryer of capacity 6 NM ³ /Min min and to match instrument air compressor with all instruments and controls as specified. | 2 | Nos | | |
| 2.4 | Air Receivers Air receiver of minimum 6 M ³ capacity with each having Pressure switches, Relief valve, Drain connection with automatic trap stations, instruments and other accessories as specified. | 4 | Nos | | |
| 2.5 | Ventilation arrangement for the compressor including ducting, support etc. | 1 | Lot | | |
| 2.6 | Inter connecting compressed air piping as specified including fitting & valves etc. | 1 | Lot | | |

6

| Clause No. | DESCRIPTION | Qty. | Unit | Unit Price (Rs) | Total Price (Rs) |
|------------|---|------|------|-----------------|------------------|
| 2.7 | All field instruments like Temperature & Pressure gauges, Pressure Transmitter & controls etc | 1 | Lot | | |
| 2.8 | Electronic Dew point meter with local display | 2 | Nos | | |
| 2.9 | Drain piping up to the nearest drain point. | 1 | Lot | | |
| 2.10 | Cable lugs, glands, etc for Compressed Air System equipment as required.. | 1 | Lot | | |
| 2.11 | Any other item not indicated above, but required to complete Compressed Air package as per system requirements. | 1 | Lot | | |
| 2.12 | Total lump sum prices for Maintenance Tool & Tackles (bidder to furnish item wise prices separately along with the price bid). | 1 | Lot | | |
| 2.13 | Total lump sum prices for commissioning spares (bidder to furnish lists of spares with item wise prices separately along with the price bid). | 1 | Lot | | |
| 2.14 | PG testing / acceptance test at site (including Instruments) | 1 | Lot | | |
| 3.0 | SUPERVISION OF ERECTION AND COMMISSIONING | | | | |
| 3.1 | No of mandays | 30 | Nos | | |
| 3.2 | No of site visits | 2 | Nos | | |

NOTES

- 1 The bidder shall furnish unit rates for variable item (marked *) i.e., desiccant cartridge type air dryer, spare desiccant cartridge etc for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract
- 2 Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient
- 3 Price format shall not be changed by the bidder

319

400MW MARIB GAS TURBINE POWER STATION (PHASE - II)

COMPRESSED AIR SYSTEM

GUARANTEED POWER CONSUMPTION FIGURES

| S.NO. | DESCRIPTION OF EQUIPMENT | NO OF EQUIPMENT | | TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL | DUTY FACTOR | TOTAL KW |
|------------|--|-----------------|---------|---|-------------|----------|
| | | WORKING | STANDBY | | | |
| 1 | 2 | 3A | 3B | 4 | 5 | 6=3Ax4x5 |
| 1 | Instrument Air Compressor (oil free Screw / Rotary Tooth type) Each of minimum 6 NM3/Min capacity at 8.0 kg/cm ² | 2 | | | | |
| 2 | Service Air Compressor (oil free Screw / Rotary Tooth type) Each of minimum 6 NM3/Min capacity at 8.0 kg/cm ² | 2 | | | | |
| 3 | Air drying plant unit (Refrigerant type) | 2 | | | | |
| TOTAL (KW) | | | | | | 340 |

| | |
|-------|--|
| Note: | <p>Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 340 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ US\$ 620 per KW of additional power over EPC.</p> <p>Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ US\$ 620 per additional KW shall be levied on vendor.</p> |
|-------|--|

ANNEXURE -1

FORMAT FOR NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector – Project Engineering Management,
PPEI Building, Plot No. 25, sector-16A
Noida -201301(U.P)

| | | |
|-----|--|--|
| Sub | No Deviation Certificate | |
| | Design, engineering, manufacturing, supply, erection, commissioning etc of AC System for Sagardighi 2 x 500 MW TPS | |
| Ref | 01 | Tendor No. |
| | 02 | BHEL 's NIT, vide reference no. |
| | 03 | BHEL's clarification / confirmation vide reference email dated |
| | 04 | Other reference (if any)/ |

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed / modified the tender documents as appeared in the web site / issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with offer references as enumerated in the above referred NIT (besides the confirmations given at Sl. No. 03 under Ref.). We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized representative of the bidder)

