# PATRATU VIDYUT UTPADAN NIGAM LIMITED

(A Subsidiary of NTPC Ltd. in Joint Venture with Jharkhand Bijli Vitran Nigam Ltd)

**PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I**

**(3 x 800 MW)**

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## *TECHNICAL SPECIFICATION*

## *FOR*

# *GYPSUM DEWATERING SYSTEM*

**(VACUUM BELT FILTER TYPE)**

## SPECIFICATION NO.: PE-TS-434-571-A001, Rev 01

**BHARAT HEAVY ELECTRICALS LIMITED**
**POWER SECTOR**
**PROJECT ENGINEERING MANAGEMENT**
**PROJECT ENGIEERING INSTITUTE BUILDING**
**SECTOR-16A, PLOT NO. 25, NOIDA, UTTAR PRADESH, INDIA**

| | 3x800 MW PATRATU TPS<br><br>GYPSUM DEWATERING SYSTEM<br>TECHNICAL SPECIFICATION | SPECIFICATION No: PE-TS-434-571-A001 |
|---|---|---|
| | | SECTION |
| | | REV. 01 |
| | | SHEET : 1 OF 2 |

**CONTENTS**

**SECTION - I**


| SUB- SECTIONS | TITLE | | Page No. |
|---|---|---|---|
| **Sub-Section-A** | INTENT OF SPECIFICATION | | 5 - 7 |
| **Sub-Section-B** | PROJECT INFORMATION | | 8 - 25 |
| **Sub-Section-C** | TECHNICAL SPECIFICATION | | 26 |
| | **Sub Section-C1** | SPECIFIC TECHNICAL REQUIREMENT | 27 - 45 |
| | **Sub Section-C2** | CUSTOMER SPECIFICATION | 46 - 144 |
| | | **C2 - A** PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING: | |
| | | GENERAL TECHNICAL REQUIREMENT | |
| | | QUALITY ASSURANCE | |
| | | DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE | |
| | | PACKING PROCEDURE | |
| | | **C2 - B** PAINTING SPECIFICATION (INCLUDING APPROVED DOCUMENT) | |
| | **Sub Section-C3** | TECHNICAL SPECIFICATION (ELECTRICAL PORTION) | 145 - 213 |
| | **Sub Section-C4** | TECHNICAL SPECIFICATION (C&I PORTION) | 214 - 368 |
| **Sub Section-D** | ANNEXURE-I | LIST OF MAKES OF SUB-VENDOR ITEMS | 369 |
| | ANNEXURE-II | MANDATORY SPARE LIST | 370 - 373 |
| | ANNEXURE-III | INSPECTION AND TESTING, STANDARD QUALITY PLAN | 374 - 390 |
| | ANNEXURE-IV | INPUT DRAWINGS (P&ID/ MECHANICAL LAYOUT DRAWINGS SHOWING LOCATION OF EQUIPMENT/ PLOT PLAN) | 391 - 410 |
| | ANNEXURE-V | MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION | 411 - 416 |
| | ANNEXURE-VI | PACKING PROCEDURE | 417 - 420 |
| | ANNEXURE-VII | SEA-WORTHY PACKING PROCEDURE | 421 - 473 |
| | ANNEXURE-VIII | PIPE & VALVE MATERIAL SPECIFICATION | 474 - 479 |


**SECTION - II**


| SUB SECTIONS | TITLE | Page No. |
|---|---|---|
| **Sub Section-1** | STANDARD TECHNICAL SPECIFICATION | 480 - 484 |


This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | 3x800 MW PATRATU TPS<br><br>GYPSUM DEWATERING SYSTEM<br>TECHNICAL SPECIFICATION | SPECIFICATION No: PE-TS-434-571-A001 |
|---|---|---|
| | | SECTION |
| | | REV. 01 |
| | | SHEET : 2 OF 2 |

**SECTION - III**


| SUB SECTIONS | TITLE | Page No. |
|---|---|---|
| **Annexure-1** | LIST OF DOCUMENTS TO BE SUBMITTED WITH BID | 485 |
| **Annexure-2** | COMPLIANCE CUM CONFIRMATION CERTIFICATE | 486 - 487 |
| **Annexure-3** | PRE-BID CLARIFICATION SCHEDULE | 488 |
| **Annexure-4** | DEVIATION SHEET (COST OF WITHDRAWAL) | 489 |
| **Annexure-5** | SCHEDULE OF GUARANTEES | 490 - 491 |
| **Annexure-6** | LIST OF MAKES OF SUB VENDOR ITEMS | 492 |
| **Annexure-7** | LIST OF TOOLS & TACKLES | 493 |
| **Annexure-8** | EQUIPMENT DATA SHEET/ SCHEDULE (TO BE FILLED BY BIDDER) | 494 - 501 |
| **Annexure-9** | LIST OF COMMISSIONING SPARES | 502 |


This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | 3x800 MW PATRATU TPS<br><br>GYPSUM DEWATERING SYSTEM | SPECIFICATION No: PE-TS-434-571-A001 |
|---|---|---|
| | | SECTION: I |
| | | REV. 01 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SECTION - I

| | 3x800 MW PATRATU TPS<br><br>TECHNICAL SPECIFICATION<br>GYPSUM DEWATERING SYSTEM<br><br>INTENT OF SPECIFICATION | SPECIFICATION No: PE-TS-434-571-A001<br>SECTION : I<br>Sub Section: A<br>REV. 01<br>SHEET 1 OF 3 |
|---|---|---|

# SECTION-I

# SUB-SECTION-A

# INTENT OF SPECIFICATION

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | 3x800 MW PATRATU TPS<br><br>TECHNICAL SPECIFICATION<br>GYPSUM DEWATERING SYSTEM<br><br>INTENT OF SPECIFICATION | SPECIFICATION No: PE-TS-434-571-A001<br>SECTION : I<br>Sub Section: A<br>REV. 01<br>SHEET 2 OF 3 |
|---|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## 1.0 INTENT OF SPECIFICATION

1.1 The specification covers Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND services part covers **supervision services for** erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the GDS- Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for Flue Gas Desulphurization (FGD) plant of **3x800 MW Patratu TPS, Ramgarh, Jharkhand** of M/s Patratu Vidyut Utpadan Nigam Limited (PVUNL), a Joint Venture amongst Govt. of Jharkhand, JUVNL, JBVNL and NTPC Ltd.

1.2 There are three (3) units each of 800 MW rating. Two (02) Sets of Gypsum Dewatering system (1 working + 1 standby) common for all three units shall be provided.

1.3 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **GYPSUM DEWATERING SYSTEM.**

1.4 The Bidder shall offer only proven design, which meets the Provenness criteria indicated in the NIT. Necessary document evidences shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their bid may not be considered for further evaluation.

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

1.6 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.

| | 3x800 MW PATRATU TPS<br><br>TECHNICAL SPECIFICATION<br>GYPSUM DEWATERING SYSTEM<br><br>INTENT OF SPECIFICATION | SPECIFICATION No: PE-TS-434-571-A001<br>SECTION : I<br>Sub Section: A<br>REV. 01<br>SHEET 3 OF 3 |
|---|---|---|

1.7 The general term and conditions, instructions to tenderers and other attachment(s) referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to the compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.8 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarification(s), in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further, in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.9 The bidder's offer shall not carry any section like clarification, interpretations and /or assumptions.

1.10 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Section -III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/it's customer.

1.11 In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner shall apply.

1.12 In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.13 For definition of words like Contractor, bidder, supplier, vendor, Customer/ Purchaser/ Employer, consultant, please refer relevant clause of General Conditions of Contract (GCC).

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | 3x800 MW PATRATU TPS<br><br>GYPSUM DEWATERING SYSTEM<br><br>PROJECT INFORMATION | SPECIFICATION No: PE-TS-434-571-A001<br>SECTION : I<br>Sub Section : B<br>REV. 01 |
|---|---|---|

**SECTION: I**

**SUB-SECTION: B**

**PROJECT INFORMATION**

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB-SECTION–I-B

# PROJECT INFORMATION

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## PATRATU STPS EXPANSION PHASE-I (3X800 MW)

**1.00.00 BACKGROUND**

A Memorandum of Agreement (MOA) has been entered on 29.07.2015 amongst Govt. of Jharkhand (GoJ), Jharkhand Urja Vikash Nigam Limited (JUVNL), Jharkhand UrjaUtpadan Nigam Limited (JUUNL), Jharkhand BijliVitaran Nigam Limited (JBVNL) and NTPC Limited to form a Joint Venture Company of NTPC Limted& JBVNL for transfer of Patratu Thermal Power Station (PTPS) located in Ramgarh District of Jharkhand State to the proposed JV Company for Performance Improvement of existing capacity & 4000 MW Capacity expansion of PTPS.

Further to signing of JV agreement on 29.07.2015, a Joint Venture Company namely Patratu Vidyut Utpadan Nigam Limited (PVUNL) has been incorporated amongst GoJ, JUVNL, JBVNL and NTPC Ltd. on 15.10.2015. The Performance Improvement of existing capacity and 4000 MW Capacity expansion of Patratu STPS will be implemented by the JV Company (JVC). The configuration of expansion of 4000 MW shall consist of 5 units of 800 MW to be implemented in two phases; Phase-I: 3x800 MW and Phase-II: 2x800 MW.

The present proposal is for Patratu STPS Phase-I (3x800 MW). The project is envisaged to be commissioned during XIII Plan period.

**2.00.00 CAPACITY**

Patratu STPS Phase-I: 3x800 MW - Present proposal

**3.00.00 MODE OF OPERATION**

Base Load

**4.00.00 LOCATION AND APPROACH**

4.01.00 Patratu Thermal Power station (PTPS) is located just outside the coal belt of South Karanpura in Ramgarh District of Jharkhand State. The nearest Railway Station is Patratu which is at a distance of about 4 km on Barkakhana-Barwadih Railway line.

4.02.00 **The latitudes and longitudes of the site are as follows:**

| Corner name | Latitude | Longitude |
|---|---|---|
| Top Corner | 23° 38 ‘ 60 ‘‘ N | 85° 17’ 51.5” E |
| Bottom Corner | 23° 38 ‘12.5 ‘‘ N | 85° 17’ 27” E |
| Left Corner | 23° 38 ‘ 22.5 ‘‘ N | 85° 17’ 10.6 ‘‘ E |
| Right Corner | 23° 38 ‘ 40 ‘‘ N | 85° 17’ 57 ‘‘ E |

4.03.00 **Airport**

The nearest commercial airport is Ranchi at about 45 km by road.

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

A copy of Vicinity plan of the project site is placed at **Annexure - I**.

**5.00.00 LAND**

The total land to be transferred to JV Company is 1859 acres. Out of 1859 acre, about 1234 acres of land has been envisaged for Plant, Ash pond and Land on railway track of the for Phase-I (3x800 MW). The balance 625 acre of land shall be transferred during commencement of Phase-II (2x800 MW).

**6.00.00 WATER**

The make-up water for PSTPS is to be met from Patratu Dam on Nalkari River (capacity 99 MCM i.e. 110 Cusecs). About 52.34 Cusecs of water will be available at 90% dependable monsoon flow after considering evaporation loss.

GoJ/JUVNL owns and controls water of Patratu Dam. GoJ/JUUNL supplies water to PTPS and to the other entities in the vicinity from this water reservoir. JUVNL had entered into agreements with these other entities for supply of water from water reservoir. JUVNL shall revisit these agreements to meet the requirement of water for expansion projects, if required.

Make up water requirement of PSTPS, Phase-I (3x800 MW) would be about 27 Cusecs with “Air Cooled Condenser” based power plant. GoJ shall provide the required water from the existing reservoir to the JV Company.

The JVC shall be responsible for the water supply arrangement starting at the downstream of intake chamber from where water supply commences for the Station. Ownership of the entire water supply system and related plant and equipment, including the water treatment plant, shall be that of the JVC and after the asset transfer, the JVC shall maintain, take care and use the same. The additional facility including addition of plant, equipment etc. for enhanced requirement (if any) and drawl of water shall be the responsibility of JVC and to be arranged by the JVC at their own cost.

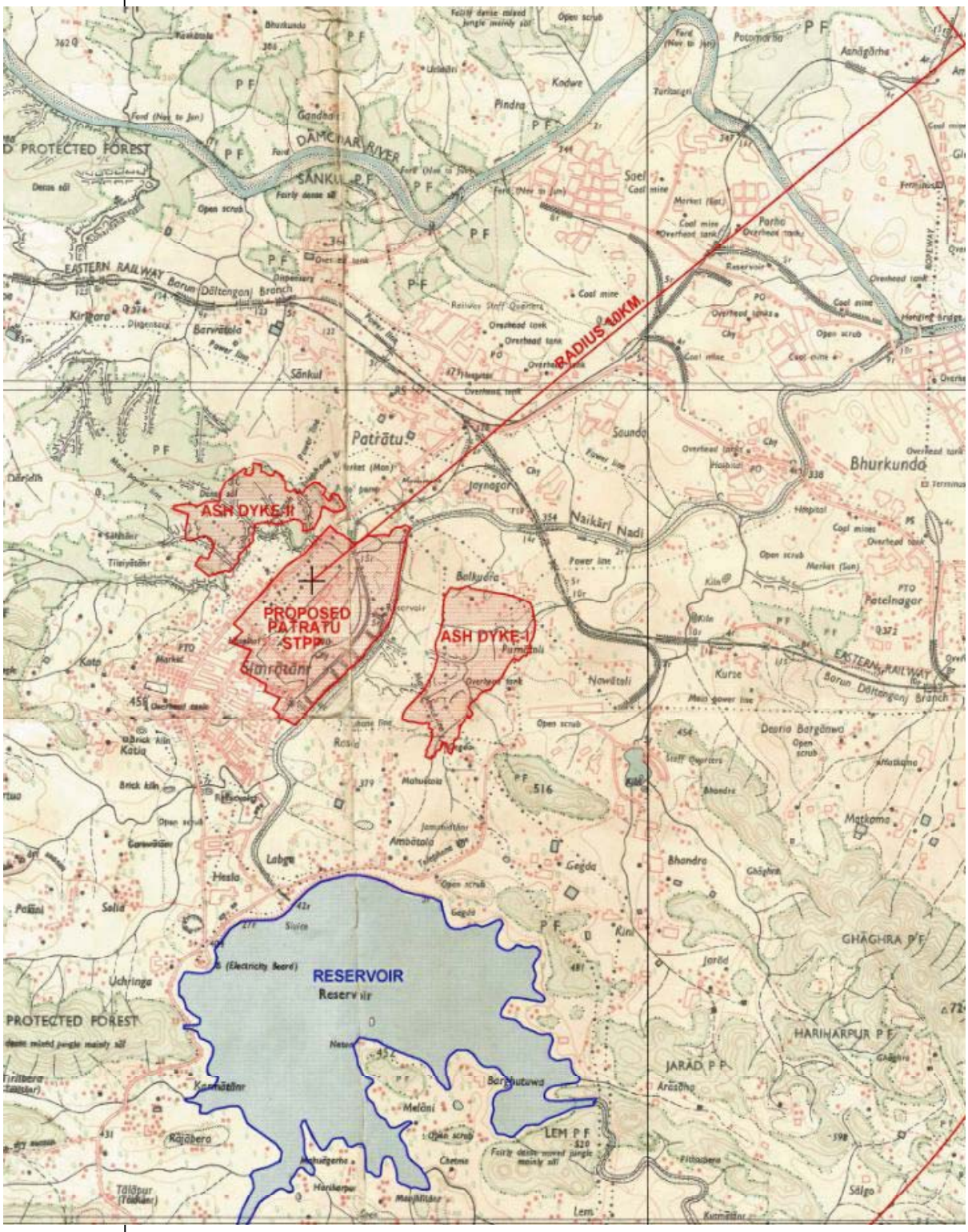
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|
| **7.00.00** | **COAL** |
| 7.01.00 | **Coal Requirement, Availability and Linkage**<br>About 12 MTPA of coal will be required to meet coal requirement of the Phase-I (3x800 MW) of the project.<br>The Banhardih captive coal block at a distance of about 155 km from plant is allocated to JUVNL for end use of Patratu expansion. The coal from Banhardih captive coal block shall be transferred to the JVC for the usage of PSTPS with the approval of Ministry of Coal, GOI. MOC (11.09.15) has accorded in-principle approval of the Central Govt. to assign Banhardih Coal Block allocated to JUVNL to the JV Company. |
| 7.02.00 | **Coal Transportation**<br>The envisaged mode of coal transportation from the coal mines to the power plant is by Indian Railways through BOBR / BOX- N wagons. |
| 7.03.00 | **Coal Quality**<br>The primary fuel for the main steam generator shall be coal. The domestic coal quality parameters are indicated in **Annexure-IV-2** and imported coal parameters are indicated in **Annexure-IV-4** are to be considered for steam generator design. |
| 7.04.00 | **Fuel Oil**<br>The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Heavy Fuel Oils having the characteristics given at **Annexure-IV-3**and Light Diesel Oil having the characteristics given at **Annexure-IV-1.** |
| **8.00.00** | **NOT USED** |
| **9.00.00** | **STEAM GENERATOR TECHNOLOGY**<br>The steam generators shall be super critical once through type, water tube, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type. |
| **10.00.00** | **FLUE GAS DESULPHURIZATION SYSTEM (FGD) &SCR:**<br>The project is envisaged with Flue Gas Desulfurization (FGD) system and SCR meeting Ministry of Environment, Forest & Climate Change notification dated 07.12.2015. Limestone to be used for design of FGD system shall be as per the characteristic given at Annexure-IV-5. |
| **11.00.00** | **POWER EVACUATION SYSTEM**<br>85% of power from the project is envisaged to be allocated to Jharkhand State subject to approval of Ministry of Power, while balance 15% would be as unallocated portion and Project is envisaged as regional project. Since major power (85%) is proposed to be absorbed by Jharkhand, the issue of Associated Transmission |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | PROJECT INFORMATION | |
|---|---|---|

**ANNEXURE-I**

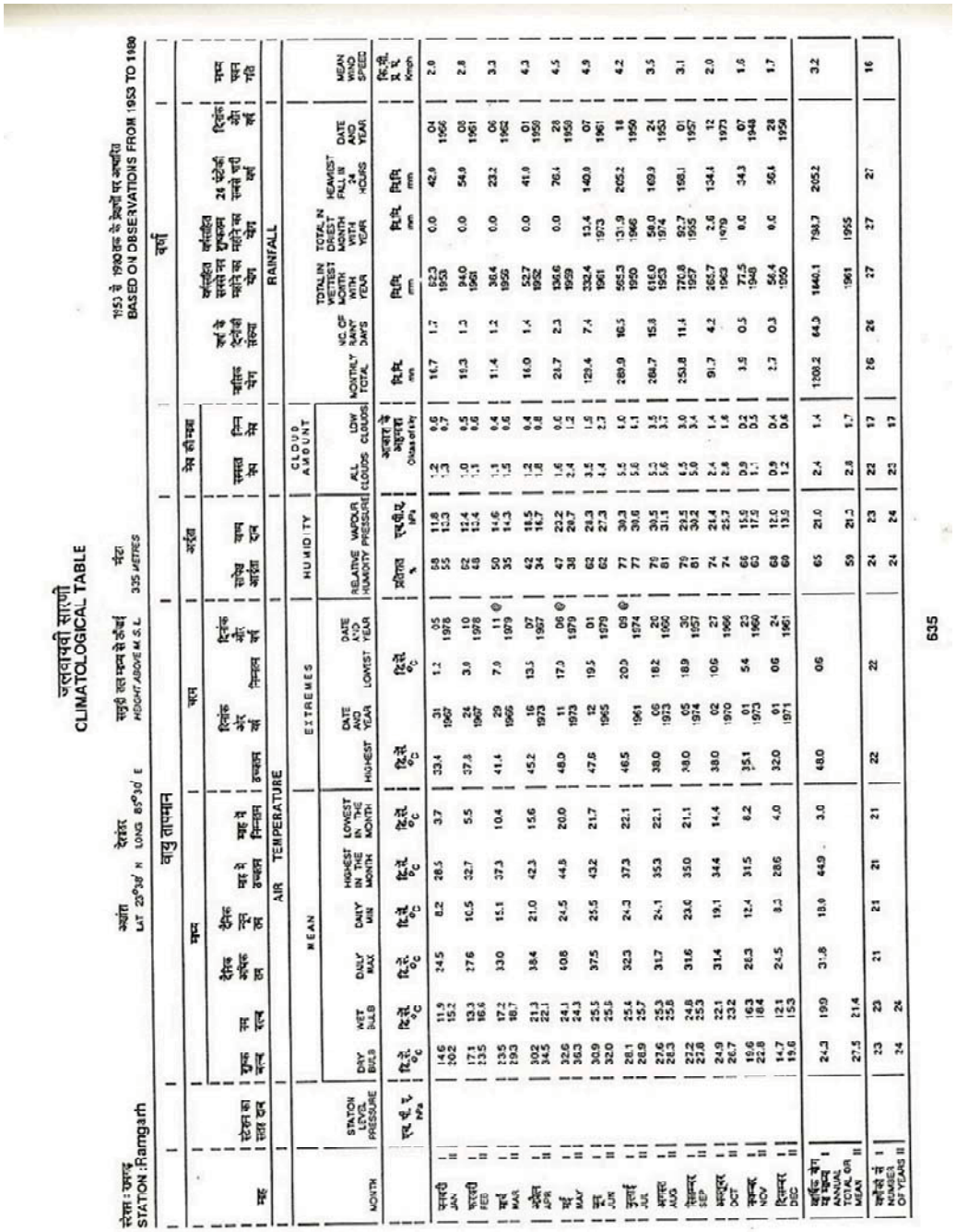



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | PROJECT INFORMATION | एनटीपीसी NTPC |
|---|---|---|

**ANNEXURE-II**

C



जलवायवी सारणी
CLIMATOLOGICAL TABLE

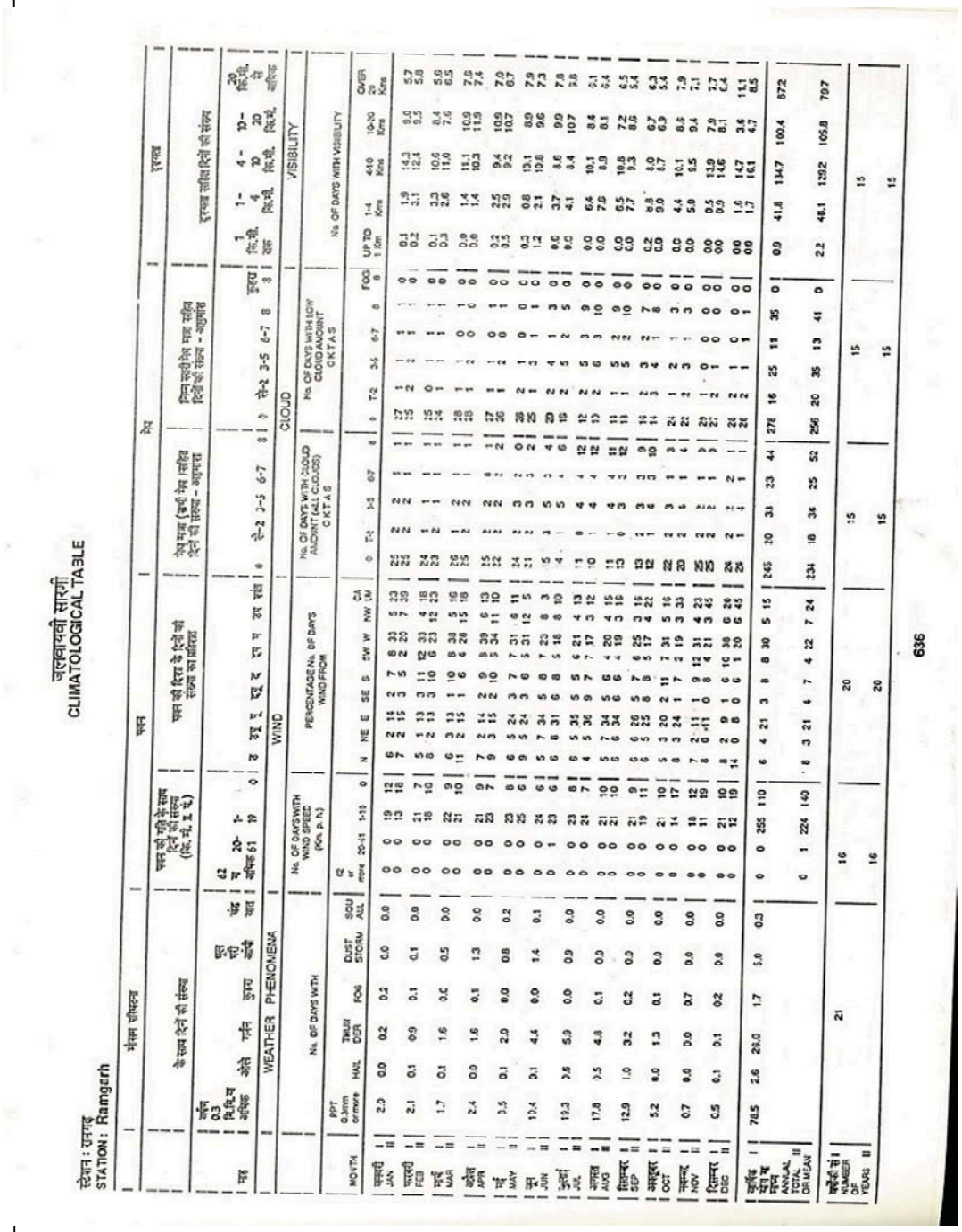
1953 से 1980 तक के वेधों पर आधारित
BASED ON OBSERVATIONS FROM 1953 TO 1980

स्टेशन : रामगढ़ STATION : Ramgarh | अक्षांश LAT 23°58′ N | देशांतर LONG 85°31′ E | समुद्र तल से ऊँचाई HEIGHT ABOVE M.S.L. 335 METRES

| माह MONTH | | स्टेशन का स्तर हेक्टे. STATION LEVEL PRESSURE | वायु तापमान AIR TEMPERATURE | | | | | | | | | | | | वर्षा RAINFALL | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | मध्य MEAN | | | | चरम EXTREMES | | | | आर्द्रता HUMIDITY | | मेघ सीमा CLOUD AMOUNT | | | | | | | | | | |
| | | | DRY BULB | WET BULB | DAILY MAX | DAILY MIN | HIGHEST IN THE MONTH | LOWEST IN THE MONTH | HIGHEST | DATE AND YEAR | LOWEST | DATE AND YEAR | RELATIVE HUMIDITY | VAPOUR PRESSURE | ALL CLOUDS | LOW CLOUDS | MONTHLY TOTAL | वर्षा के दिनों की संख्या NO. OF RAINY DAYS | TOTAL IN WETTEST MONTH WITH YEAR | TOTAL IN DRIEST MONTH WITH YEAR | HEAVIEST FALL IN 24 HOURS | DATE AND YEAR | MEAN WIND SPEED |
| | | हेक्टे. hPa | °C | °C | °C | °C | °C | °C | °C | | °C | | % | hPa | Oktas in key | Oktas in key | mm | | mm | mm | mm | | Km/h |
| जनवरी JAN | I | | 14.6 | 11.9 | 24.5 | 8.2 | 28.5 | 3.7 | 33.4 | 31 1967 | 1.2 | 05 1978 | 58 | 11.8 | 1.2 | 0.5 | 16.7 | 1.7 | 52.3 1953 | 0.0 | 42.9 | 04 1956 | 2.0 |
| | II | | 20.2 | 15.2 | | | | | | | | | 55 | 13.3 | 1.3 | 0.7 | | | | | | | |
| फरवरी FEB | I | | 17.1 | 13.3 | 27.6 | 10.5 | 32.7 | 5.5 | 37.8 | 24 1967 | 3.0 | 10 1978 | 52 | 12.4 | 1.0 | 0.5 | 15.3 | 1.3 | 94.0 1961 | 0.0 | 54.9 | 08 1961 | 2.8 |
| | II | | 23.5 | 18.6 | | | | | | | | | 48 | 13.4 | 1.5 | 0.6 | | | | | | | |
| मार्च MAR | I | | 23.5 | 17.2 | 33.0 | 15.1 | 37.3 | 10.4 | 41.4 | 29 1965 | 7.0 | 11 @ 1979 | 50 | 14.6 | 1.5 | 0.4 | 11.4 | 1.2 | 30.4 1956 | 0.0 | 23.2 | 06 1952 | 3.3 |
| | II | | 29.3 | 18.7 | | | | | | | | | 35 | 14.3 | 1.5 | 0.6 | | | | | | | |
| अप्रैल APR | I | | 30.2 | 21.3 | 38.4 | 21.0 | 42.3 | 15.6 | 45.2 | 16 1973 | 13.5 | 07 1957 | 42 | 18.5 | 1.2 | 0.4 | 16.0 | 1.4 | 52.7 1952 | 0.0 | 41.0 | 01 1950 | 4.3 |
| | II | | 34.5 | 22.1 | | | | | | | | | 34 | 16.7 | 1.8 | 0.8 | | | | | | | |
| मई MAY | I | | 32.6 | 24.1 | 40.8 | 24.5 | 44.8 | 20.0 | 48.0 | 11 1973 | 17.0 | 06 @ 1979 | 47 | 22.2 | 1.6 | 0.6 | 21.7 | 2.3 | 136.6 1959 | 0.0 | 76.4 | 28 1950 | 4.5 |
| | II | | 36.3 | 24.3 | | | | | | | | | 38 | 23.7 | 2.4 | 1.2 | | | | | | | |
| जून JUN | I | | 30.9 | 25.5 | 37.5 | 25.5 | 43.2 | 21.7 | 47.6 | 12 1965 | 19.5 | 01 1979 | 62 | 24.3 | 3.5 | 1.5 | 129.4 | 7.4 | 332.4 1961 | 13.4 1973 | 140.9 | 07 1961 | 4.9 |
| | II | | 32.0 | 25.5 | | | | | | | | | 62 | 27.3 | 4.4 | 2.3 | | | | | | | |
| जुलाई JUL | I | | 28.1 | 25.4 | 32.3 | 24.3 | 37.3 | 22.1 | 46.5 | 1961 | 20.0 | 09 @ 1974 | 77 | 30.2 | 5.5 | 1.0 | 289.0 | 16.5 | 565.3 1980 | 131.9 1966 | 205.2 | 18 1950 | 4.2 |
| | II | | 28.9 | 25.7 | | | | | | | | | 77 | 30.6 | 5.6 | 1.1 | | | | | | | |
| अगस्त AUG | I | | 27.6 | 25.3 | 31.7 | 24.1 | 35.3 | 22.1 | 38.0 | 08 1973 | 18.2 | 20 1960 | 78 | 30.5 | 5.3 | 3.5 | 286.7 | 15.8 | 616.0 1953 | 54.0 1974 | 169.9 | 24 1953 | 3.5 |
| | II | | 28.3 | 25.8 | | | | | | | | | 81 | 31.1 | 5.6 | 3.7 | | | | | | | |
| सितम्बर SEP | I | | 27.2 | 24.8 | 31.6 | 23.4 | 35.0 | 21.1 | 38.0 | 05 1974 | 18.9 | 30 1957 | 79 | 29.5 | 5.5 | 3.0 | 253.8 | 11.4 | 720.8 1957 | 92.7 1955 | 159.1 | 01 1957 | 3.1 |
| | II | | 27.8 | 25.3 | | | | | | | | | 81 | 30.2 | 5.9 | 3.4 | | | | | | | |
| अक्टूबर OCT | I | | 24.9 | 22.1 | 31.4 | 19.1 | 34.4 | 14.4 | 38.0 | 02 1970 | 10.6 | 27 1966 | 74 | 24.4 | 2.4 | 1.4 | 91.7 | 4.2 | 265.7 1963 | 2.6 1979 | 134.4 | 12 1973 | 2.0 |
| | II | | 26.7 | 23.2 | | | | | | | | | 74 | 25.3 | 2.6 | 1.6 | | | | | | | |
| नवम्बर NOV | I | | 19.6 | 16.3 | 28.3 | 12.4 | 31.5 | 8.2 | 35.1 | 01 1973 | 5.4 | 23 1960 | 68 | 15.9 | 0.9 | 0.2 | 3.5 | 0.5 | 77.5 1948 | 0.0 | 34.3 | 07 1948 | 1.6 |
| | II | | 22.8 | 18.4 | | | | | | | | | 63 | 17.5 | 1.1 | 0.3 | | | | | | | |
| दिसम्बर DEC | I | | 14.7 | 12.1 | 24.5 | 8.2 | 28.6 | 4.0 | 32.0 | 01 1971 | 0.6 | 24 1961 | 68 | 12.0 | 0.9 | 0.4 | 2.7 | 0.3 | 56.4 1950 | 0.0 | 56.4 | 28 1950 | 1.7 |
| | II | | 15.6 | 15.3 | | | | | | | | | 69 | 13.9 | 1.2 | 0.6 | | | | | | | |
| वार्षिक मान या कुल ANNUAL TOTAL OR MEAN | I | | 24.3 | 19.9 | 31.8 | 18.9 | 44.9 | 3.0 | 48.0 | | 0.6 | | 65 | 21.0 | 2.4 | 1.4 | 1209.2 | 64.9 | 1440.1 | 794.7 | 205.2 | | 3.2 |
| | II | | 27.5 | 21.4 | | | | | | | | | 59 | 21.3 | 2.8 | 1.7 | | | 1961 | 1955 | | | |
| वर्षों की संख्या NUMBER OF YEARS | I | | 23 | 23 | 21 | 21 | 21 | 21 | 22 | | 22 | | 24 | 23 | 22 | 17 | 26 | 26 | 27 | 27 | 27 | | 16 |
| | II | | 24 | 24 | | | | | | | | | 24 | 24 | 23 | 17 | | | | | | | |

535

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : रामगढ़
STATION : Ramgarh

636

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**ANNEXURE- (d)**

**CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**

All structures shall be designed for wind forces in accordance with IS 875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS 875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

**Damping in Structures**

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Welded steel structures : 1.0%

b) Bolted steel structures : 2.0%

c) Reinforced concrete structures : 1.6%

d) Steel stacks : As per IS 6533 & CICIND Model Code whichever is more critical.

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed “$V_b$” at ten metre above the mean ground level: 39 metre/second

b) The risk coefficient “$K_1$” : 1.06

c) Category of terrain : Category-2

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**Annexure-(E)**

**CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005. Pending finalization of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Annexure-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Annexure-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4).

**Damping in Structures**

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

| | | |
|---|---|---|
| Steel structures | | 2 % |
| Reinforced structures | Concrete | 5 % |
| Reinforced Stacks | Concrete | 3 % |
| Steel stacks | | 2 % |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**Method of Analysis**

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

For buildings, if the design base shear (VB) obtained from modal combination is less than the base shear ( $\bar{V}B$) computed using the approximate fundamental period (Ta) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}B$/ VB. However, no reduction is permitted if $\bar{V}B$ is less than VB.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Annexure-I. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve.

**Design/Detailing for Ductility for Structures**

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**Annexure-2**

## CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

### Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

| | | | |
|---|---|---|---|
| a) | Steel structures | : | 2% |
| b) | Reinforced Concrete structures | : | 5% |
| c) | Reinforced Concrete Stacks | : | 3% |
| d) | Steel stacks | : | 2% |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**Method of Analysis**

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear ($V_B$) obtained from modal combination is less than the base shear ( $\bar{V}_B$) computed using the approximate fundamental period ($T_a$) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B$/ $V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than $V_B$.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.

**Design/Detailing for Ductility for Structures**

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

**APPENDIX – I**

## SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.41 g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for ordinary moment resisting steel frames designed and detailed as per IS:800 | : 0.103 |
| b) | for braced steel frames designed and detailed as per IS:800 | : 0.077 |
| c) | For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.062 |
| d) | for RCC chimney | : 0.205 |
| e) | for liquid retaining tanks | : 0.123 |
| f) | for steel chimney | : 0.154 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below | : 0.103 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.205 |

Notes:
1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**(In units of 'g')**

| Time Period (Sec) | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| | 2% | 3% | 5% |
| 0 | 1.000 | 1.000 | 1.000 |
| 0.03 | 1.000 | 1.000 | 1.000 |
| 0.04 | 1.555 | 1.405 | 1.293 |
| 0.05 | 2.190 | 1.828 | 1.578 |
| 0.06 | 2.898 | 2.267 | 1.857 |
| 0.07 | 3.670 | 2.720 | 2.131 |
| 0.075 | 3.670 | 3.175 | 2.267 |
| 0.08 | 3.670 | 3.175 | 2.500 |
| 0.083 | 3.670 | 3.175 | 2.500 |
| 0.085 | 3.670 | 3.175 | 2.500 |
| 0.09 | 3.670 | 3.175 | 2.500 |
| 0.1 | 3.670 | 3.175 | 2.500 |
| 0.105 | 3.670 | 3.175 | 2.500 |
| 0.11 | 3.670 | 3.175 | 2.500 |
| 0.115 | 3.670 | 3.175 | 2.500 |
| 0.12 | 3.670 | 3.175 | 2.500 |
| 0.125 | 3.670 | 3.175 | 2.500 |
| 0.13 | 3.670 | 3.175 | 2.500 |
| 0.135 | 3.670 | 3.175 | 2.500 |
| 0.14 | 3.670 | 3.175 | 2.500 |
| 0.145 | 3.670 | 3.175 | 2.500 |
| 0.15 | 3.670 | 3.175 | 2.500 |
| 0.2 | 3.670 | 3.175 | 2.500 |
| 0.22 | 3.670 | 3.175 | 2.500 |
| 0.23 | 3.670 | 3.175 | 2.500 |
| 0.24 | 3.670 | 3.175 | 2.500 |
| 0.3 | 3.670 | 3.175 | 2.500 |
| 0.35 | 3.670 | 3.175 | 2.500 |
| 0.4 | 3.670 | 3.175 | 2.500 |
| 0.45 | 3.111 | 2.822 | 2.222 |
| 0.5 | 2.800 | 2.540 | 2.000 |
| 0.55 | 2.545 | 2.309 | 1.818 |
| 0.6 | 2.333 | 2.117 | 1.667 |
| 0.65 | 2.154 | 1.954 | 1.538 |
| 0.7 | 2.000 | 1.814 | 1.429 |
| 0.75 | 1.867 | 1.693 | 1.333 |
| 0.8 | 1.750 | 1.588 | 1.250 |
| 0.85 | 1.647 | 1.494 | 1.176 |
| 0.9 | 1.556 | 1.411 | 1.111 |
| 0.95 | 1.474 | 1.337 | 1.053 |
| 1 | 1.400 | 1.270 | 1.000 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**(In units of 'g')**

| Time Period (Sec) | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| | 2% | 3% | 5% |
| 1.05 | 1.333 | 1.210 | 0.952 |
| 1.1 | 1.273 | 1.155 | 0.909 |
| 1.15 | 1.217 | 1.104 | 0.870 |
| 1.2 | 1.167 | 1.058 | 0.833 |
| 1.25 | 1.120 | 1.016 | 0.800 |
| 1.3 | 1.077 | 0.977 | 0.769 |
| 1.35 | 1.037 | 0.941 | 0.741 |
| 1.4 | 1.000 | 0.907 | 0.714 |
| 1.45 | 0.966 | 0.876 | 0.690 |
| 1.5 | 0.933 | 0.847 | 0.667 |
| 1.55 | 0.903 | 0.819 | 0.645 |
| 1.6 | 0.875 | 0.794 | 0.625 |
| 1.65 | 0.848 | 0.770 | 0.606 |
| 1.7 | 0.824 | 0.747 | 0.588 |
| 1.75 | 0.800 | 0.726 | 0.571 |
| 1.8 | 0.778 | 0.706 | 0.556 |
| 1.85 | 0.757 | 0.686 | 0.541 |
| 1.9 | 0.737 | 0.668 | 0.526 |
| 1.95 | 0.718 | 0.651 | 0.513 |
| 2 | 0.700 | 0.635 | 0.500 |
| 2.05 | 0.683 | 0.620 | 0.488 |
| 2.1 | 0.667 | 0.605 | 0.476 |
| 2.15 | 0.651 | 0.591 | 0.465 |
| 2.2 | 0.636 | 0.577 | 0.455 |
| 2.25 | 0.622 | 0.564 | 0.444 |
| 2.3 | 0.609 | 0.552 | 0.435 |
| 2.35 | 0.596 | 0.540 | 0.426 |
| 2.4 | 0.583 | 0.529 | 0.417 |
| 2.45 | 0.571 | 0.518 | 0.408 |
| 2.5 | 0.560 | 0.508 | 0.400 |
| 2.55 | 0.549 | 0.498 | 0.392 |
| 2.6 | 0.538 | 0.488 | 0.385 |
| 2.65 | 0.528 | 0.479 | 0.377 |
| 2.7 | 0.519 | 0.470 | 0.370 |
| 2.8 | 0.500 | 0.454 | 0.357 |
| 2.85 | 0.491 | 0.446 | 0.351 |
| 2.9 | 0.483 | 0.438 | 0.345 |
| 2.95 | 0.475 | 0.431 | 0.339 |
| 3 | 0.467 | 0.423 | 0.333 |
| 3.05 | 0.459 | 0.416 | 0.328 |
| 3.1 | 0.452 | 0.410 | 0.323 |
| 3.15 | 0.444 | 0.403 | 0.317 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**(In units of 'g')**

| Time Period (Sec) | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| | 2% | 3% | 5% |
| 3.2 | 0.438 | 0.397 | 0.313 |
| 3.25 | 0.431 | 0.391 | 0.308 |
| 3.3 | 0.424 | 0.385 | 0.303 |
| 3.35 | 0.418 | 0.379 | 0.299 |
| 3.4 | 0.412 | 0.374 | 0.294 |
| 3.45 | 0.406 | 0.368 | 0.290 |
| 3.5 | 0.400 | 0.363 | 0.286 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | **Annexure-(f)**<br><br>**QA REQUIREMENT**<br><br>All Civil, Structural and Architectural construction work at the project shall be executed strictly in accordance with the Quality Assurance guidelines specified in separate part of this Specification. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | 3x800 MW PATRATU TPS<br>GYPSUM DEWATERING SYSTEM<br><br>TECHNICAL SPECIFICATION | SPECIFICATION No: PE-TS-434-571-A001 |
|---|---|---|
| | | SECTION : I |
| | | Sub Section : C |
| | | REV. 01 |

# SECTION: I

# SUB SECTION: C

# TECHNICAL SPECIFICATION

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | 3x800 MW PATRATU TPS<br><br>TECHNICAL SPECIFICATION<br>GYPSUM DEWATERING SYSTEM<br><br>SPECIFIC TECHNICAL REQUIREMENT | SPECIFICATION No: PE-TS-434-571-A001<br>SECTION : I<br>SUB-SECTION : C1<br>REV. 01<br>SHEET 1 OF 19 |
|---|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SECTION: I

# SUB-SECTION: C 1

# SPECIFIC TECHNICAL REQUIREMENT

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| 1.1 | FUNCTION |
|---|---|

The purpose of the specification is to provide complete Gypsum Dewatering System (GDS) for PVUNL Patratu TPS 3x800 MW, under the scope of this tender.

| 1.2 | TECHNICAL INFORMATION | |
|---|---|---|
| 1.2.1 | Quantity of Gypsum De-Watering System (GDS) | Two (2) Sets<br>(one working +one standby) |
| 1.2.2 | Capacity of gypsum dewatering system | 136.0 Tones per hour (wet cake) minimum at outlet of Vacuum belt filter for each belt filter |
| 1.2.3 | Moisture content | 10% (max) |
| 1.2.4 | Chloride content | 100 ppm or less |
| 1.2.5 | Gypsum purity | 90% or more [by BHEL] |

| 2.1 | SCOPE OF SUPPLY & SERVICES |
|---|---|

The specification covers Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND services part covers **supervision services for** erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the GDS- Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (6 man-days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories

**Design:** Broadly includes basic engineering, detail engineering, preparation and submission of engineering drawings/ calculations/ datasheets/ quality assurance documents/field quality plans, storage instructions, commissioning procedures, Erection & assembly Drawings, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from Customer.

**Supply:** Broadly Includes manufacturing/ fabrication, shop floor testing, stage inspections, final inspections, painting, packing & forwarding.

**Services**: Broadly includes supervision services for erection & commissioning, trial run at site and carrying out Performance Guarantee tests at site, training of Customer's Engineering Personnel at manufacturer's works covering design familiarization, training on product design features etc. (6 man-days including lodging and boarding), training of Customer's O&M staff covering all aspects of Operation & Maintenance, Troubleshooting etc. (6 days) at Site & handover in flawless condition of the package to the customer.

2.1.1 The scope of supply for Gypsum Dewatering System shall include but not limited to the following:

2.1.1.1 Primary hydro cyclone: Two (2) sets

i. Hydrocyclone clusters
ii. Anchor bolts, nuts and washers

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

iii. Flanges for inlet and overflow
iv. A variety size of vortex finders for all the hydro cyclone
v. Accessory piping within the skid
vi. Piping, valves, instruments as per the terminal points defined elsewhere in the specification

2.1.1.2 Secondary hydro cyclone: Two (2) sets
i. Hydrocyclone clusters
ii. Anchor bolts, nuts and washers
iii. Flanges for inlet and overflow
iv. A variety size of vortex finders for all the hydro cyclone
v. Accessory piping within the skid
vi. Piping, valves, instruments as per the terminal points defined elsewhere in the specification

2.1.1.3 Vacuum belt filters complete with Accessories including discharge chute up to the gypsum conveyor skirt board (*width of Gypsum conveyor belt is 650 mm and that of skirt board top is 433 mm*), driving motors (IE3) inverter duty with VFD and inverter panel: Two (2) numbers

2.1.1.4 Vacuum receivers with Anchor bolts, nuts and washers: Two (2) Sets.

Filtrate extraction pumps (total 2 nos., 1 no. per receiver tank) shall be provided. Refer Scheme No. PE-FEP-00 for the typical arrangement. The extraction system of the filtrate complete with pumps, valves, instruments and accessories along with associated supports, fasteners, gaskets etc. with drive (IE3 motor). Bidder to also include all connection bolts/nuts/washers for installation. Required instruments and any safety device shall be supplied.

Bidder to include the same in the P&ID scheme & submit for the approval of BHEL/Customer.

2.1.1.5 Vacuum pumps with drive (IE3 motor), All connection bolts/nuts/washers for installation, Required instruments and any safety device: Two (2) numbers

Bidder to consider the requirement of the vertical seal water sump pumps (2 nos., 1 working + 1 stand by) in scope for pumping the water expended from the Vacuum pump(s) to the Cake/cloth Wash Tank(s).

Civil work of the sump shall be in BHEL scope and the bidder shall provide inputs.

The system shall be complete with pumps, valves, instruments and accessories along with associated supports, fasteners, gaskets etc. with drive (IE3 motor). Also, bidder to include all connection bolts/nuts/washers for installation. Required instruments and any safety device shall be supplied.

Bidder to include the same in the P&ID scheme & submit for the approval of BHEL/Customer.

2.1.1.6 Vent fan including enclosure and its complete arrangement from VBF till exhaust: Two (2) numbers

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

2.1.1.7 Complete arrangement for Filter Cloth and Gypsum Cake washing (excluding Tanks & their Instruments), pumps with motors (IE3), associated piping, valves, spray nozzles & accessories for: One (1) set*

Two (2) nos. of belt filter cum cake washing tanks are envisaged for both the belt filters. Each tank shall be provided with 2 nos. (1 working + 1 standby) of wash pumps. The bidder shall provide suitable arrangement for the washing of belt filter cloth and gypsum cake including piping / valves / instruments etc.

The Scope of supply of Wash tank(s) with inlet/outlet nozzle and its instrumentation is in BHEL's scope. Inlet piping along with associated instruments/ valves from process water Terminal point (TP) to the tanks inlet nozzles, Process water Outlet piping from the tanks outlet nozzles for cake wash and belt wash comprising of the wash pumps, their motors (IE3) along with associated instruments/ valves etc. shall be in the bidder scope.

However, bidder scope shall be limited to the Engineering as per clause 2.1.1.9 (ii) (g) of this sub-section for the overflow and drain of the tanks.

2.1.1.8 Coupling with guards, wherever applicable: One (1) set*

2.1.1.9 Piping, Valves and Accessories

(i) Complete engineering and supply of interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable, shall be supplied in erectable condition i.e., no rubber lining to be done at Site), instruments, valves, supports, gaskets, fasteners and accessories which is integral to Gypsum Dewatering System – One (1) set* which is broadly defined below:

a. Slurry piping from Primary hydro cyclones underflow to Vacuum Belt Filters

b. Filtrate piping from Vacuum belt filters to Vacuum receivers and further up to the extraction pumps discharge.

c. Air piping from vacuum receivers to vacuum pumps to atmosphere

d. Vacuum pumps seal water / drain water pipes to/ from wash tanks. Supply of seal water to vacuum pump shall be provided through clarified water pump as specified in P&ID. Seal water drain from vacuum pump shall be collected in sump pit and shall be routed back to clarified water tank through seal water sump pump as mentioned at clause 2.1.1.5 above.

e. Process water piping from TP outside building to wash tanks along with overflow and drain piping of tanks.

f. Instrument air piping from TP outside building up to equipment related to the system

(ii) Scope of below-mentioned interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable, shall be supplied in erectable condition i.e., no rubber lining to be done at Site), supports, gaskets, fasteners and accessories which is non

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

integral to Gypsum Dewatering System are **limited to engineering only** and supply shall be made by BHEL. **Engineering includes layout & routing of pipes, preparation of isometric drawing and BOQ:**

a. Primary hydro cyclone feed tank outlet to the inlet flange of Primary hydro cyclones along with recirculation piping to feed tank

b. Primary hydro cyclones over flow to Inlet of secondary hydro cyclone feed tank

c. Secondary hydro cyclone feed tank outlet to inlet flange of secondary hydro cyclones along with recirculation piping to feed tank

d. Secondary hydro cyclones underflow to filtrate tank

e. Secondary hydro cyclones overflow to inlet flange of waste water tank

f. Vacuum receiver drain through filtrate extraction pumps (bidder scope) to Filtrate tank and other associated drains of vacuum belt filters to filtrate tank

g. Overflow and drain piping of cake/cloth wash tanks.

2.1.1.10 Expansion Joints at suction and discharge of each pump/other equipment, as applicable: One (1) Set*

2.1.1.11 Instruments for the entire gypsum dewatering system including integral piping as defined at 2.1.1.9 above (minimum requirement for each gypsum dewatering system is given in the P&ID): One (1) set*

2.1.1.12 Electric equipments common including but not limited to

i. Local control panel, if required
ii. LV, HT Motors (as applicable)
iii. Junction Box
iv. Instruments
v. Push buttons

2.1.1.13 All motors shall be provided with suitable double compression cable gland.

Sizes of cables shall be informed by BHEL during detail engineering. Bidder to provide suitable gland with respect to sizes of cables.

Bidder shall provide cable glands and lugs for all equipment in his scope. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs.

Bidder shall provide junction box. The Junction box shall have provision for installing glands of suitable size on the bottom of the box.

2.1.1.14 Control System: Control system shall be DDCMIS/ DCS which shall be BHEL scope. Each equipment shall be furnished with required instrumentation and electrical accessory devices mounted and connected to a junction box/ cabinet.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

2.1.1.15 **SIGNALS [Refer Electrical/C&I portion/ P&IDs of this specification, as well]**

2.1.1.15.1 Alarm Signal:

a) Bearing temperature high: Bidder shall supply bearing Temperature Transmitter for initiating alarm for "Bearing temperature high". Bearing temperature transmitter shall be provided with local display also. Bearing temperature transmitter (with 2V3 logic) shall be provided for HT motors (> 200 KW) at both the driving and non-Driving ends.

b) Vibration Monitoring System, is envisaged for HT Motor, which is in BHEL scope. However, for mounting of vibration sensors/probe on DE&NDE Bearing, vendor to provide vibration pad (of dimension of 80mm x 80mm x 10mm each) for mounting of sensors with a provision i.e. M6x1 threaded hole, 13mm deep, predrilled in each pads. Bidder to provide Single notch/slot (of dimension 30mm x 15mm x 3mm) on the circumference of the coupling of Motor for mounting of key phasor. There shall be space and provision in the assembled machine train for mounting the phase marker bracket supplied by BHEL.

2.1.1.15.2 Interlock signal:

a) Cake/Belt filter wash tank level low
b) Cake/Belt filter wash tank level high

2.1.1.16 First fill lubricants: All the first fill and one year's toppings requirements of consumables such as grease, oil, lubricants, servo fluids etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion to facilities should be provided by contractor/supplier. Refer Clause 7.0 of this sub-section for further details.

2.1.1.17 Suitable Painting and rust prevention during shipment and construction.

2.1.1.18 Seaworthy packing & forwarding to project site (applicable where the equipment is transported through sea route). Refer project information specified elsewhere in the specification. Otherwise, packing specification of equipment of Indian origin will be followed.

2.1.2 Services to be provided by the bidder:

(i) Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.

(ii) Supervision for Erection & Commissioning, trial run at site

(iii) Performance guarantee tests at site & handover in flawless condition of the package to the customer

(iv) Training of customer/ clients' O&M staff covering all aspects of the GDS- Operation & Maintenance, Trouble-shooting etc. at site (6 days)

(v) Training of customer at manufacturer's works covering design familiarization, training on product design features etc. (6 man-days including lodging and boarding)

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

(vi) For supervision services, visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site. Bidder shall be informed around 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert of bidder as deemed necessary.

2.1.3 Mandatory spares as defined as Annexure-II, Sub Section-D of Section I.

2.1.4 Recommended spare parts list to be furnished (is not part of scope of supply)

2.1.5 Any other items required not covered above but required for the completeness of the system; same shall be included in the offer and shall be supplied by the Bidder/supplier. Bidder shall refer to the P&ID enclosed in Annexure-IV, Sub-Section-D of Section-I for the items under the bidder's scope. All the items indicated in the P&ID are minimal requirements.

[*Wherever (*) is marked, one (1) set means complete requirement for both the Gypsum Dewatering System*]

| 2.2 | PROCESS DESCRIPTION |
|---|---|
| 1. | Common gypsum dewatering system is envisaged for all three units. The dewatering system shall receive the gypsum slurry from Primary Hydro cyclone feed pumps (BHEL Scope). Gypsum dewatering system shall be suitable for handling slurry from all three FGD absorber units. Two sets of primary hydrocyclone (1W+1S) with accessories shall be in vendor scope. Primary hydrocyclone underflow shall be taken to VBF inlet. |
| 2. | The overflow from the primary sets of hydro-cyclone shall be taken to a secondary hydro-cyclone feed tank (BHEL Scope). Secondary Hydro cyclone feed pumps (BHEL Scope) shall transfer the slurry from tanks to secondary hydro cyclone. Two sets of Secondary hydro cyclones (1 working+1 stand by) and its accessories shall be in vendor scope. Bidder shall offer the suitable combination of hydrocyclone clusters as per the requirement. |
| 3. | The underflow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water storage tank. |
| 4. | Two (2) nos. of belt filter cum cake washing tank (BHEL scope) is envisaged for both the belt filters. Each tank shall be provided with 2 nos. of belt filter wash cum cake wash pumps. |

| 2.3 | TERMINAL POINTS |
|---|---|
| 1. | Primary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of the primary hydro cyclone. |
| 2. | Primary hydro cyclone overflow launder outlet flange. Further piping by BHEL to secondary hydrocyclone feed tank. |
| 3. | Secondary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of secondary hydro cyclone. |
| 4. | Secondary hydro cyclone underflow launder outlet flange and overflow launder outlet flange. Further piping by BHEL to waste water and filtrate tank. |
| 5. | Outlet flanges at filtrate extraction pumps discharge expansion joints and TP near VBF for other drain such as cloth wash, dyke drain etc. |
| 6. | Process/clarified water & instrument air will be provided at one location, located at 5 m from building boundary. Further piping from terminal point to GDS system utilities are in bidder's scope. |

| | |
|---|---|
| 7. | Discharge of Gypsum through discharge chute onto the gypsum belt conveyor is in bidder's scope. Please refer enclosed P&IDs, typical layout & preliminary drawing of GDS for the details in the scope. |

2.4 For Electrical scope, refer Electrical specification (Sub-section- C3, Section-I).

2.5 For Control & Instrumentation (C&I) scope, refer C&I specification (Sub-section- C4, Section-I).

## 3.0 CODES & STANDARDS AND OTHER REQUIREMENTS

3.1 The design and manufacturing of vacuum belt filter shall follow the latest applicable Indian / International (ASME / EN /Japanese) Standards.

3.2 The performance tests shall be carried out in accordance with ASME PTC 40 (2017) code.

3.3 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

a) Indian Electricity Act
b) Indian Electricity Rules
c) Indian Explosives Act
d) Indian Factories Act and State Factories Act
e) Indian Boiler Regulations (IBR)
f) Regulations of the Central Pollution Control Board, India
g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
h) Pollution Control Regulations of Department of Environment, Government of India
i) State Pollution Control Board.
(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996
(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
(m.) Explosive Rules, 1983
(n.) Petroleum Act, 1984
(o.) Petroleum Rules, 1976,
(p.) Gas Cylinder Rules, 1981
(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
(r.) Workmen's Compensation Act, 1923
(s.) Workmen's Compensation Rules, 1924
(t.) PVUNL Safety Rules for Construction and Erection
(u.) PVUNL Safety Policy
(v.) Any other statutory codes / standards / regulations, as may be applicable.

3.4 Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

a) Bureau of Indian standards (BIS)

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

b) Japanese Industrial Standards (JIS)
c) American National Standards Institute (ANSI)
d) American Society of Testing and Materials (ASTM)
e) American Society of Mechanical Engineers (ASME)
f) American Petroleum Institute (API)
g) Standards of the Hydraulic Institute, U.S.A.
h) International Organization for Standardization (ISO)
i) Tubular Exchanger Manufacturer's Association (TEMA)
j) American Welding Society (AWS)
k) National Electrical Manufacturers Association (NEMA)
l) National Fire Protection Association (NFPA)
m) International Electro-Technical Commission (IEC)
n) Expansion Joint Manufacturers Association (EJMA)
o) Heat Exchange Institute (HEI)
p) IEEE standard
q) JEC standard

3.5 Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the BHEL Customer's approval, for which the bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases, the bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

3.6 Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.

3.7 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the BHEL shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of BHEL such changes and advise BHEL of the resulting effect.

## 4.0 DETAILED TECHNICAL SPECIFICATION

| | |
|---|---|
| 4.1 | DETAILED SPECIFICATION |
| 4.1.1 | Bidder shall supply two stage gypsum dewatering system consisting of primary hydro cyclones, vacuum belt filters and secondary hydro cyclones for dewatering of gypsum from absorber to less than 10% moisture at the design capacity specified elsewhere in the specification. |
| 4.1.2 | Bidder shall supply 2x100% gypsum dewatering system with each stream sized to dewater **136 TPH (Wet cake)** produced by the all three FGD units operating at design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification. |
| 4.2 | Hydro-cyclones |
| 4.2.1 | Two (2) sets of primary hydro cyclones are envisaged, each set shall be sized to dewater the gypsum slurry produced by the unit operating at design point. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 4.2.2 | Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service. |
| 4.2.3 | The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant P&IDs. |
| 4.2.4 | The primary hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters. |
| 4.2.5 | The Primary hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The feed chamber shall be provided with a minimum lining thickness of 25 mm. Liners shall have a **minimum wear life of not less than 7000 hours**. |
| 4.2.6 | Two (2) sets of secondary hydro cyclones are to be installed. Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. |
| 4.3 | Vacuum Belt Filters (VBF) |
| 4.3.1 | Two (2) numbers of Vacuum Belt Filters each of capacity **136 TPH (Wet cake)** is envisaged. Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum:<br>▪ Outlet Moisture: 10% (maximum)<br>▪ Chloride content: 100 ppm (maximum)<br>▪ Gypsum Purity: 90% (minimum) – by BHEL |
| 4.3.2 | The Vacuum Belt Filters shall have the following characteristics:<br>a) Very rigid frame and rolls, no deformation whatsoever may occur.<br>b) All rolls shall be installed perfectly horizontally<br>c) There shall be no vacuum under the slurry deposition zone.<br>d) Deposit thickness control and directional stability control<br>e) The slurry shall be put on the belt in counter current relative to the rotation of band.<br>f) The vacuum chambers shall be easily opened for inspection and cleaning. |
| 4.3.3 | The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for **a minimum life of not less than 7000 hours**. In case the bidder does not stand guarantee for specified life, they shall supply additional sets of filter cloth(s) to meet the cumulative life of 7000 hours. The same is applicable for main as well as mandatory spares and shall be supplied along with main supplies and mandatory spares. |
| 4.3.4 | The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design. Accordingly, bidder may consider 'Corten / Weathering Steel' or 'SS 304' or any other suitable corrosion resistant material conforming to ASTM A606-4, A588, A847 etc. as applicable. The material so selected, should be meeting the strength requirement of the belt filter. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 4.3.5 | In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have **minimum life of not less than 7000 hours**.<br>In case the bidder does not stand guarantee for specified life, they shall supply additional sets of filter cloth(s) to meet the cumulative life of 7000 hours. The same is applicable for main as well as mandatory spares and shall be supplied along with main supplies and mandatory spares. |
| 4.3.6 | The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design. |
| 4.3.7 | The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the bidder's proven practice. The belt filter shall have an automatic cloth tensioning mechanism. Pull chord switches shall be provided for each vacuum belt filter. Four (04) no.'s of Belt sway switches shall be provided for each vacuum belt filter. Cake thickness sensors with double redundancy shall be provided for each vacuum belt filter which shall control the speed of the vacuum belt filter in turn. |
| 4.3.8 | Differential Pressure indicator shall be provided at the discharge line of Belt filter wash Pump for each vacuum Belt filter. Flow indicator shall be provided for cloth washing line of each vacuum belt filter. Flow indicator shall be provided for cake washing line of each vacuum belt filter as per P&ID enclosed. |
| 4.3.9 | The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided. |
| 4.3.10 | The filtrate from gypsum slurry and cake washing shall be taken to single/ multiple vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump. |
| 4.3.11 | Gypsum cake from each belt filter shall be discharged through a suitable chute onto belt conveyor being provided by BHEL. Direct impact of material on conveyor belt shall be avoided by providing suitable chute arrangement. Gypsum Handling Conveyor Belt (BHEL's scope) width shall be of 650 mm. |
| 4.3.12 | A 2 m (min.) wide platform shall be provided all around each belt filter for easy approach & maintenance. or it may provide a common platform of **3.3m** (approx.) width. In case, common platform for VBF is provided, a movable platform along with access ladder shall be provided for approaching components on other side of VBF. The elevation of discharge point of vacuum belt filter shall be as per the Drawing of Gypsum Dewatering Building provided in the Sub Section-7 of Section-II. Any changes for optimization of the layout shall be suggested by Bidder accordingly. |
| 4.3.13 | The service factor of the gear unit (if any) shall be minimum 1.5. |
| 4.3.14 | Piping and wiring within the skid should be in the vendor's scope. |
| 4.3.15 | All client end connection flanges shall be ANSI B 16.5/AWWA. |
| 4.4 | Vacuum System |
| 4.4.1 | The filtrate from each set of the belt filter and cake washing shall be taken to single/multiple receiver tank(s) as per the supplier's proven practice. Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional 10% margin over the above shall be provided each vacuum pump. |
| 4.4.2 | Each Vacuum pump shall have its own piping system, which connects the pump with the associated vacuum belt filter. Bidder to provide Equipment layout and General Arrangement (GA) of Gypsum dewatering building along with the offer. |
| 4.4.2 | The vacuum pump shall be of low speed liquid ring type of proven design. The design of the |

| | |
|---|---|
| | vacuum pumps shall avoid cavitation under all operating conditions. |
| 4.4.3 | The seals shall be of proven design. |
| 4.4.4 | Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification. |
| 4.4.5 | The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application. |
| 4.4.6 | Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm. |
| 4.4.7 | The filtrate extraction pump shall be capable of pumping filtrate water with solid concentration not less than 10% and particle lumps of 6-7 mm. A 10% margin shall be provided in each of the pump. |
| 4.5 | COMMON REQUIREMENTS FOR PUMPS (Vacuum, Filtrate Extraction, Cake/Cloth Wash) |
| 4.5.1 | All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a hi-chrome alloy line pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations. |
| 4.5.2 | All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized/ pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. The process water lines shall be provided with pneumatic/motorized valves as per the proven practice of the Bidder. |
| 4.5.3 | The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy-duty ball/roller bearings. |
| 4.5.4 | All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions. |
| 4.5.5 | Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods. |
| 4.5.6 | Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1 m to the max NPSH required shall be provided. |
| 4.5.7 | All pumps shall be fitted with suction and discharge pressure gauges. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves. All the wetted parts shall be SS 316 or equivalent. |
| 4.5.8 | Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps. |
| 4.5.9 | Pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line. Check valve/ NRVs have to be considered as per requirement of system. |
| 4.5.10 | Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be minimum 115% of Best Efficiency Point (BEP). |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 4.5.11 | Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection of Duty point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising its NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and are at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly. |
| 4.5.12 | External flushing is required to remove the accumulated particles and all related information should be mentioned in datasheet. |
| 4.5.13 | Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing. |
| 4.5.14 | In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting. |
| 4.5.15 | Each pump will have a coupling of adequate size, designed for full load and capable of supporting start–up on overload moments. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller. |
| 4.5.16 | The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted. |
| 4.5.17 | The sealing areas shall be designed in such a way so that solids do not precipitate in them or affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred. |
| 4.5.18 | Pump induced vibration due to flow pulsations shall be avoided through suitable design. |
| 4.5.19 | Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft). |
| 4.5.20 | The material and thickness of the liners of slurry pumps (Filtrate Extraction pumps) shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be **guaranteed for a minimum wear life of not less than 14000 hours.** |
| 4.5.21 | Coupling halves shall be machine matched to ensure accurate alignment. Couplings must have a rated capacity of at least 120% of the maximum potential power transmission requirement. |
| 4.5.22 | All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. Coupling shall be of flexible type made of cast steel. The bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the pump and the motor by bidder. The coupling between shafts shall be so designed that they become tight during pump operation. |
| 4.5.23 | A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump. |
| 4.5.24 | Pump manufacturer is to supply base plate along with Foundation bolt & Nut, "Taper wedge" and the necessary fastener for Pump and Motor with Base plate. Even if Motor is excluded from their scope, necessary fastener for motor foot with base plate will remain in pump scope of supply in order to avoid any problem. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 4.5.25 | Nameplate: All equipment shall be provided with name plates indicating the item number and service name. Nameplates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided. |
| 4.5.26 | Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location. |
| 4.5.27 | Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment. |
| 4.5.28 | Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site. |
| 4.5.29 | Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing. |
| 4.5.30 | Provide double nuts for anchor bolts. |
| 4.5.31 | Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings. |
| 4.5.32 | If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner. |
| 4.6 | GENERAL |
| 4.6.1 | Bidder shall provide the mating flanges with the necessary gaskets. |
| 4.6.2 | All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction. |
| 4.6.3 | Bidder to provide capacity of crane or hoist required for safe material handling and the details of heaviest component to be handled. |
| 4.6.4 | Bidder to provide Pipe & Valve Material as per the Annexure VIII, Sub-Section-D, Section-I of the Specification. |
| 4.6.5 | A 1000 mm wide platform with suitable approach shall be provided by the bidder for each hydrocyclone. |
| 4.6.6 | A 1500 mm space around all the pumps shall be provided by the bidder during finalization of layout. |
| 4.6.7 | “Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5 m height from the nearest platform. Below this height, a vertical ladder with minimum clear width of 600 mm may also be acceptable.”<br>With reference to above, bidder is required to furnish input to BHEL suiting to the layout requirement. |
| 4.6.8 | The list of all Bought out items with makes and country of origin and contact details of the manufacturers to be mentioned along with offer to be submitted. Acceptance of makes shall be subject to BHEL’s Customer’s acceptance during the detailed engineering without cost and delivery implication to BHEL. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## 5.0 PROCESS FLOW DIAGRAMs (PFDs) & P&IDs

The Piping and Instrumentation Diagram are enclosed in Annexure-IV, Sub-Section-D of Section-I.

| 5.1 | PROCESS PARAMETERS FOR PRIMARY HYDROCYCLONE | | | |
|---|---|---|---|---|
| S.no | Parameters | Primary Hydro Cyclone Feed Slurry | Primary Hydro Cyclone Over Flow | Primary Hydro Cyclone-Under Flow |
| a. | Total Flow ($m^3$/hr.) | 709.9 | 528.0 (*1) | 181.7 (*1) |
| b. | Total Flow (t/hr.) | 835.3 | 588.2 (*1) | 247.1 (*1) |
| c. | Operating Temp (C) | 63 | 63 | 63 |
| d. | Design Temp (C) | 70 | 70 | 70 |
| e. | Solid (wt. %) | 25 | 16.6 (*1) | > 45 (*2) |
| f. | Density (Kg/$m^3$) | 1177 | 1114 (*1) | 1360 (*1) |
| g. | pH | 4-7 | 4-7 | 4-7 |
| h. | Cl-(mg/l) | 25000 | 25000 | 25000 |

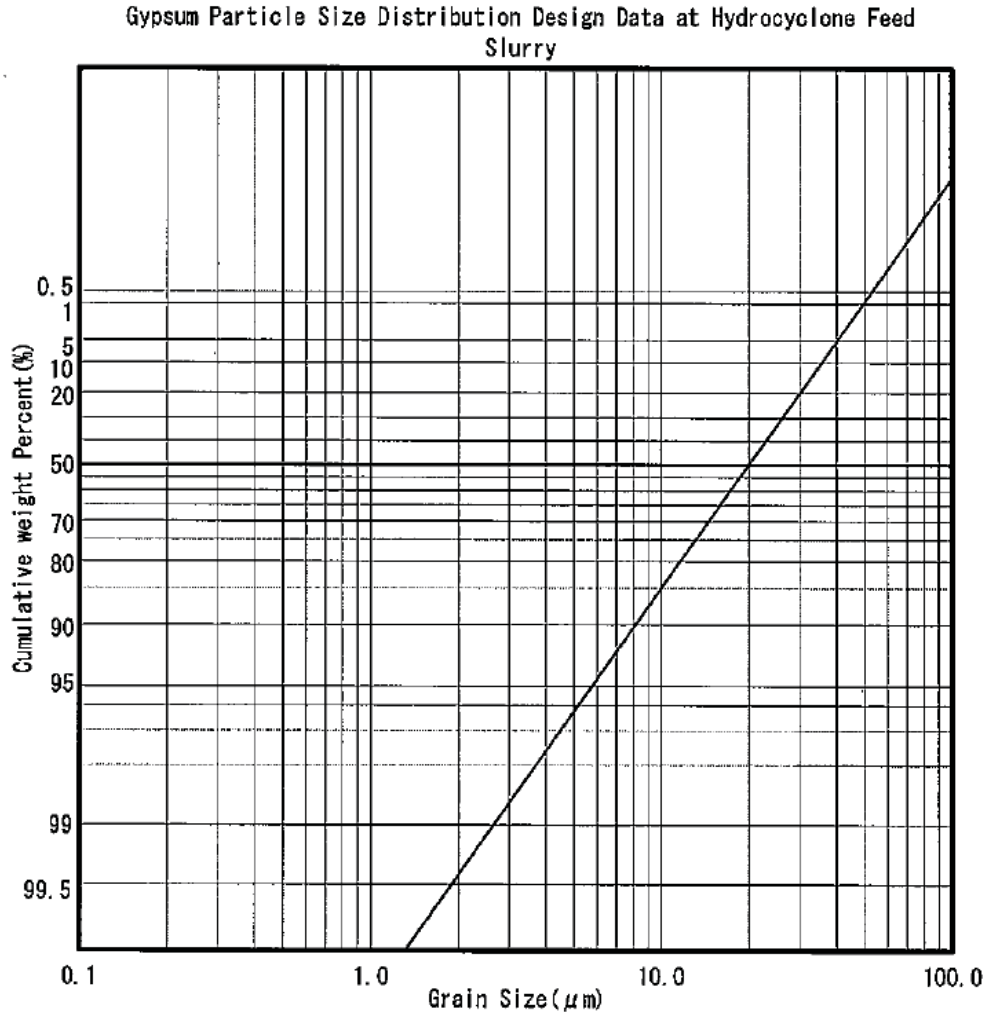
| 5.2 | PROCESS PARAMETERS FOR SECONDARY HYDROCYCLONE | | | |
|---|---|---|---|---|
| a. | Parameters | Secondary Hydro cyclone – Feed Slurry | Secondary Hydro cyclone-Overflow | Secondary Hydro cyclone-Under flow |
| b. | Total flow ($m^3$/hr) | 528.0 | 329.9 (*1) | 198.1 (*1) |
| c. | Total flow (t/hr) | 588.2 | 338.2 (*1) | 250 (*1) |
| d. | Operating Temp (° C) | 63 | 63 | 63 |
| e. | Design Temp (C) | 70 | 70 | 70 |
| f. | Solid (wt %) | 16.6 | 3 (*2) | 35 (*1) |
| g. | Density (kg/$m^3$) | 1114 | 1025 | 1262 |
| h. | pH | 4-7 | 4-7 | 4-7 |
| i. | $Cl^-$ (mg/l) | 25000 | 25000 | 25000 |

| 5.3 | DATA SHEET OF BELT FILTER: | | | | |
|---|---|---|---|---|---|
| | Parameters | Belt Filter Feed Slurry | Product Gypsum | Filtrate | Washing Water** |
| a. | Total Flow ($m^3$/hr) | 181.7 (*1) | | | |
| b. | Total Flow (t/hr)-Wet | 247.1 (*1) | 122.9 | | |
| c. | Temp (°C) | 70.0 | | | |
| d. | Solid (% wt) | >45 (*2) | >90 (*2) | <0.2 | |
| e. | Slurry conc. (% wt) | 1360 (*1) | >90 | | |
| f. | pH | 4~7 | 5~8 | | |
| g. | Cl | <25000 | <100 ppm (*2) | | |
| h. | Belt filter and the peripherals shall be designed at 136 TPH (wet cake) discharge of product gypsum<br>**a.** **Quantity of water shall be finalized by the vendor.<br>**b.** *Property of process water is as given in 5.7. | | | | |
| i. | *1) shall be finalized by vendor.<br>*2) Shall be guaranteed by vendor | | | | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| 5.4 | GYPSUM PARTICLE SIZE AT HYDRO CYCLONE FEED SLURRY IS SHOWN BELOW: | | |




Note:
1. Vendor to submit the Particle Size Distribution (PSD) based on their design for PHC & SHC underflow and overflow
2. Hydro cyclone backpressure shall not exceed 20m H.

| | | | |
|---|---|---|---|
| 5.5 | GYPSUM PARTICLE SIZE AT BELT FILTER FEED SLURRY IS SHOWN BELOW: | | |
| | Vendor to submit PSD graph design data at VBF inlet / PHC outlet. | | |
| 5.6 | DESIGN CONDITIONS OF PRIMARY & SECONDARY HYDRO CYCLONES: | | |
| 1. | Primary hydrocyclone quantity | : | 2 sets (1W+1SB) |
| 2. | Secondary hydrocyclone quantity | : | 2 sets (1W+1SB) |
| 3. | Primary hydrocyclone capacity | : | 781 $m^3$/hr each |
| 4. | Secondary hydrocyclone capacity | : | 581 $m^3$/hr each |
| 5. | Type of hydro cyclone | : | Vertical |
| 6. | Material (MOC) of Cyclone Clusters | : | Polyurethane/Urethane |
| 7. | MOC of Feed chamber | : | CS+25 mm rubber lining |
| 8. | MOC of overflow chamber | : | CS+12mm rubber lining |
| 9. | MOC of under flow chamber | : | CS+12mm rubber lining |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| 5.7 | PROCESS WATER CHARACTERISTICS | | |
|---|---|---|---|
| **S.No.** | **Constituents** | **Unit** | **Water quality** |
| 1. | Calcium as $CaCo_3$ | ppm | 145.5 |
| 2. | Magnesium as $CaCo_3$ | ppm | 81 |
| 3. | Sodium as $CaCo_3$ | ppm | 70 |
| 4. | Potassium as $CaCo_3$ | ppm | 7 |
| 5. | Iron as Fe | ppm | 0.3 |
| 6. | Total alkalinity as $CaCo_3$ | ppm | 187.6 |
| 7. | Chlorides as $CaCo_3$ | ppm | 62.3* |
| 8. | Sulphate as $CaCo_3$ | ppm | 54.5 |
| 9. | pH | | 7.0 – 8.2 |
| 10. | Turbidity | NTU | <5 |
| | | | |

Note: Process water will be used for belt/cloth and gypsum cake washing. Any treatment, if required shall be in the bidder's scope.

***Chloride in ppm – 44.17**

| **6.0** | **SPARES, TOOLS & TACKLES** |
|---|---|
| 6.1 | START UP & COMMISSIONING SPARES |
| | Start-up & Commissioning Spares shall be part of the main supply of the GDS. Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares required for successful operation till commissioning of GDS shall come under this category. Bidder shall provide an adequate stock of such start-up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at Site before the equipment's are energized. List shall be furnished by bidder along with bid as indicated at Section-III. |
| 6.2 | MANDATORY SPARES |
| | a) The list of mandatory spares considered essential by the BHEL's Customer/Employer is indicated in Annexure-II of Sub Section-D of Section-I in the specification. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidder's design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in their Bid. Whenever the quantity is mentioned in "sets", the bidder has to give the item details and prices of each item.<br><br>b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| | module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.<br><br>c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly.<br><br>d) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.<br><br>e) The Employer reserves the right to buy any or all the mandatory spare parts.<br><br>f) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.<br><br>Bidder to provide the split up price for mandatory spares during placement of order as per price format. |
| 6.3 | RECOMMENDED SPARES: |
| | In addition to the spare parts mentioned above, the bidder shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list. This list shall take into consideration the mandatory spares specified in the relevant sub-Section and should be independent of the list of the mandatory spares. |
| 6.4 | SPECIAL TOOLS & TACKLES: |
| | Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools. List shall be furnished by bidder along with bid as indicated at Section-III. |

| | |
|---|---|
| **7.0** | **FIRST FILL OF CONSUMABLES** |

| | |
|---|---|
| 7.1 | Bidder's scope shall include supply and filling of all the first fill and one year's topping requirement of consumables, greases, oils, all chemicals, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals. |
| 7.2 | Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants of each variety of lubricants, servo fluids, gases, chemicals etc. (as applicable) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers. |

| | |
|---|---|
| 7.3 | Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the BHEL/BHEL's Customer's approval herein shall be furnished within 2 months of placement of Order. On completion of erection, complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. |

## 8.0 LIST OF REFERENCE DRAWINGS BY BHEL

The drawings specified in in Annexure-IV, Sub-Section-D of Section-I are being provided along with the tender specification for engineering, estimation and calculation purpose of the bidder.

## 9.0 PAINTS /PAINTING

Bidder shall follow BHEL/ Customer painting philosophy specified Sub-Section- C2-B Section-I in the specification. Painting Schedule (Drawing No. 9585-001-109-PVM-H-001) is provided. However, for components where no specific requirement is stipulated, the bidder shall follow its standard practice suitable for operating condition and subject to customer approval during detail engineering.

## 10.0 EXCLUSIONS

Below are excluded from scope of the GDS Supplier:

a) All utilities such as instrument air and process water up to terminal point
b) Control System (excluding Junction box)
c) Lifting equipments for Material handling
d) 3D Modeling
e) Gypsum Conveyor from the discharge of chute.
f) Tanks and their instruments & Slurry Pumps (except Filtrate Extraction).
g) Vibration Monitoring System for HT motors.
h) Civil work.

## 11.0 BID EVALUATION CRITERIA FOR POWER CONSUMPTION – Refer Annexure-IV of Price Schedule

Bidder is required to quote (GPC) Guaranteed Power Consumption (**base value as 735 KW**) in the price schedule issued along with NIT. In case of non-submission of filled up format, the bid shall be liable for rejection. Value for power consumption quoted by the bidder in the specified format, shall be considered as final and any request by bidder for any change in quoted power consumption at any later date, shall not be considered by BHEL.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SECTION: I

# SUB-SECTION: C 2

# CUSTOMER SPECIFICATION

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SECTION: I

# SUB-SECTION: C 2A

# CUSTOMER SPECIFICATIONS
# PROJECT SPECIFIC GENERAL REQUIREMENTS

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# PART - C

# GENERAL TECHNICAL REQUIREMENTS

NOT-APPLICABLE PORTION ARE REMOVED FROM GTR

# GENERAL TECHNICAL REQUIREMENTS

## PART - C

## CONTENTS


| Clause No. | Description | Page No. |
|---|---|---|
| 1.00.00 | Introduction | 1 |
| 2.00.00 | Brand Name | 1 |
| 3.00.00 | Base Offer & Alternate Proposals | 1 |
| 4.00.00 | Completeness of Facilities | 1 |
| 5.00.00 | Codes & Standards | 2 |
| 6.00.00 | Equipment Functional Guarantee | 4 |
| 7.00.00 | Design of Facilities/ Maintenance & Availability Considerations | 5 |
| 8.00.00 | Documents, Data and Drawings to be furnished by Contractor | 6 |
| 9.00.00 | Technical Co-ordination Meeting | 22 |
| 10.00.00 | Design Improvements | 22 |
| 11.00.00 | Equipment Bases | 23 |
| 12.00.00 | Protective Guards | 23 |
| 13.00.00 | Lubricants, Servo fluids and Chemicals | 23 |
| 14.00.00 | Lubrication | 24 |
| 15.00.00 | Material of Construction | 24 |
| 16.00.00 | Rating Plates, Name Plates & Labels | 24 |
| 17.00.00 | Tools and Tackles | 25 |
| 18.00.00 | Welding | 25 |


This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01


| Clause No. | Description | Page No. |
|---|---|---|
| 19.00.00 | Colour Code for All equipments/Pipings/PIpeServices | 26 |
| 20.00.00 | Protection and Preserveative shop Coating | 26 |
| 21.00.00 | Quality Assurance Programme | 27 |
| 22.00.00 | General Requirements - Quality Assurance | 28 |
| 23.00.00 | Quality Assurance Documents | 33 |
| 24.00.00 | Project Manager's Supervision | 35 |
| 25.00.00 | Inspection, Testing and Inspection Certificates | 36 |
| 26.00.00 | Pre-commissioning and Commissioning Facilities | 39 |
| 27.00.00 | Taking over | 42 |
| 28.00.00 | Training of Employer's Personnel | 42 |
| 29.00.00 | Safety Aspects during Construction and Erection | 44 |
| 30.00.00 | Noise Level | 44 |
| 31.00.00 | Packaging and Transportation | 45 |
| 32.00.00 | Electrical Equipments/Enclosures | 45 |
| 33.00.00 | Instrumentation and Control | 45 |
| 34.00.00 | Electrical Noise Control | 46 |
| 35.00.00 | Surge protection for solid state equipment | 47 |
| 36.00.00 | Instrument Air System | 47 |
| 37.00.00 | Tapping Points for Measurements | 47 |
| 38.00.00 | System Documentation | 47 |
| 39.00.00 | Maintenance Manuals of Electronic Modules | 48 |

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 6.02.00 | Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification. |
| 7.00.00 | **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS** |
| 7.01.00 | **DESIGN OF FACILITIES**<br><br>All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.<br><br>The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit. |
| 7.02.00 | **MAINTENANCE AND AVILABILITY CONSIDERATIONS**<br><br>Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.<br><br>Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage.<br><br>Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.<br><br>Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 8.00.00 | **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR** |
| 8.01.00 | Bidders may note that this is a turnkey contract. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works.<br><br>The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.<br><br>A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications. |
| 8.02.00 | The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification. |
| 8.03.00 | The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following: |
| 8.03.01 | A) **BASIC ENGINEERING DOCUMENTATION**<br><br>Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:<br><br>i) System description of all the mechanical, electrical, control & instrumentation & civil systems.<br><br>ii) Technology scan for each system / sub-system & equipment.<br><br>iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.<br><br>iv) Optimisation studies including thermal cycle optimisation.<br><br>v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Water Balance diagram.

viii) Operation Philosophy and the control philosophy of the Main Plant and other plants.

ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the station.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, process and instrumentation diagrams along with write up and system description.

iv) Start up curves for boiler and both turbines and boiler combined together as a unit for various start ups, viz. cold, warm and hot start up.

v) Piping isometric, composite layout and fabrication drawings.

vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans, BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc.

ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes..

xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).

xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xiii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xv) Protection system diagrams and relay settings.

xvi) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report and power system stability study report.

xxii) Control system configuration diagrams and card circuit diagrams and maintenance details.

xxiii) Detailed DDCMIS system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling ,sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

The Contractor's while sumitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

**A) ERECTION MANUALS**

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

**B) OPERATION & MAINTENANCE MANUALS**

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows :

1) Chapter 1 - Plant Description : To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.<br><br>(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.<br><br>(g) Long term maintenance schedules<br><br>(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.<br><br>(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement..<br><br>(j) Tolerance for fitment of various components.<br><br>(k) Details of sub vendors with their part no. in case of bought out items.<br><br>(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.<br><br>(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.<br><br>(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.<br><br>(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied. |
| 8.03.03 | After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.<br><br>If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|

the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering.The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C.The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located in Main Power Block area, covering Transformer Yard, TG building (including all facilities ), Boiler area, ESP area, chimney area and any other facility located in Main Plant Block area in an integrated & intelligent 3D software solution using rule based, data centric 3D design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model.

All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer.

After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the employer for its reference.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project . The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer piror to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this turnkey package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

8.04.00 **ENGINEERING INFORMATION SUBMISSION SCHEDULE**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

i) Information that shall be submitted for the approval to the Employer before proceeding further, and

ii) Information that would be submitted for Employer's information only.

The Master Drawing List(MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| **8.05.00** | **Engineering Co-ordination Procedure** |
| 8.05.01 | The following principal coordinators will be identified by respective organizations at time of award of contract :<br><br>NTPC Engineering Coordinator (NTPC EC) :<br><br>Name :<br><br>Designation :<br><br>Address :<br><br>a) Postal :<br><br>b) Telegraphic / e-Mail :<br><br>c) FAX : TELEPHONE :<br><br>Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):<br><br>Name :<br><br>Designation :<br><br>Address :<br><br>a) Postal :<br><br>b) Telegraphic / e-Mail :<br><br>c) FAX : TELEPHONE : |
| 8.05.02 | All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations. |
| 8.05.03 | Contractor's/Vendor's Drawing Submission and Approval Procedure :<br><br>a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".<br><br>b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) **Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.**

g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

| | |
|---|---|
| CATEGORY- I: | Approved |
| CATEGORY- II | Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. |
| CATEGORY –III | Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. |
| CATEGORY -IV | For information and records. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

8.06.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.06.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 8.06.02 | The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer. |
| 9.00.00 | **TECHNICAL CO-ORDINATION MEETING** |
| 9.01.00 | The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions. |
| 9.02.00 | The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule.The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing. |
| 9.02.01 | The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself. |
| 9.02.02 | Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof. |
| 9.03.0 | Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date. |
| 10.00.00 | **DESIGN IMPROVEMENTS**<br><br>The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.<br><br>If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 14.01.00 | Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions. |
| 15.00.00 | **MATERIAL OF CONSTRUCTION** |
| 15.01.00 | All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications. |
| 16.00.00 | **RATING PLATES, NAME PLATES & LABELS** |
| 16.01.00 | Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer. |
| 16.02.00 | Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications. |
| 16.03.00 | Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. |
| 16.04.00 | Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum. |
| 16.05.00 | Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. |
| 16.06.00 | Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. |
| 16.07.00 | Safety and relief valves shall be provided with the following:<br><br>a) Manufacturer's identification. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | b) Nominal inlet and outlet sizes in mm.<br><br>c) Set pressure in Kg/cm$^2$ (abs).<br><br>d) Blowdown and accumulation as percentage of set pressure.<br><br>e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute. |
| 16.08.00 | All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided. |
| 16.09.00 | All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system. |
| 17.00.00 | **TOOLS AND TACKLES**<br><br>The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.<br><br>The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer. |
| 18.00.00 | **WELDING** |
| 18.01.00 | If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work. |
| 19.00.00 | **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES** |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 19.01.00 | All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage. |
| 20.00.00 | **PROTECTION AND PRESERVATIVE SHOP COATING** |
| 20.01.00 | **PROTECTION**<br><br>All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification. |
| 20.02.00 | **PRESERVATIVE SHOP COATING**<br><br>All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.<br><br>Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date. |
| 20.03.00 | Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer. |
| 20.04.00 | All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer. |
| 20.05.00 | All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 20.06.00 | Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications. |
| 21.00.00 | **QUALITY ASSURANCE PROGRAMME** |
| 21.01.00 | To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following:<br><br>a) His organisation structure for the management and implementation of the proposed quality assurance programme<br><br>b) Quality System Manual<br><br>c) Design Control System<br><br>d) Documentation Control System<br><br>e) Qualification data for Bidder's key Personnel.<br><br>f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.<br><br>g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.<br><br>h) Control of non-conforming items and system for corrective actions.<br><br>i) Inspection and test procedure both for manufacture and field activities.<br><br>j) Control of calibration and testing of measuring testing equipments.<br><br>k) System for Quality Audits.<br><br>l) System for indication and appraisal of inspection status.<br><br>m) System for authorising release of manufactured product to the Employer. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | n) System for handling storage and delivery.<br><br>o) System for maintenance of records, and<br><br>p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as **Annexure-I** and **Annexure-II** respectively. |
| 22.00.00 | **GENERAL REQUIREMENTS - QUALITY ASSURANCE** |
| 22.01.00 | All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished. |
| 22.02.00 | Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I) |
| 22.03.00 | Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II). |
| 22.04.00 | The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning. |
| 22.05.00 | The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. |
| 22.06.00 | The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities. |
| 22.07.00 | No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). |
| 22.08.00 | All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details |
| 22.09.00 | All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.<br><br>All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing. |
| 22.10.00 | All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. |
| 22.11.00 | All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.. |
| 22.12.00 | For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding |
| 22.13.00 | All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes. |
| 22.14.00 | No welding shall be carried out on cast iron components for repair. |
| 22.15.00 | Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only. |
| 22.16.00 | All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.<br><br>In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.. |
| 22.17.00 | The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at **Annexure-IV.** Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract. |
| 22.18.00 | For components/equipment procured by the contractors for the purpose of the |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract. |
| 22.19.00 | Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance. |
| 22.20.00 | The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan. |
| 22.21.00 | Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc. |
| 22.22.00 | For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable. |
| 22.23.00 | Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative. |
| 22.24.00 | **Environmental Stress Screening**<br><br>All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

contractor / sub – contractor should meet the following.

**1)** The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

**Or**

In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

**Elevated Temperature Test Cycle**

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

**2)** **Burn in Test Cycle**

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| | be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.<br><br>During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature. |
| 22.25.00 | The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage. |
| 23.00.00 | **QUALITY ASSURANCE DOCUMENTS** |
| 23.01.00 | The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick ( ✓)mark. |
| 23.01.01 | Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.<br><br>The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.<br><br>The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks. |
| 23.02.00 | Typical contents of QA Documentation is as below:-<br><br>(a.) Quality Plan<br><br>(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.<br><br>(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.<br><br>(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. |

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | (e.) Heat Treatment Certificate/Record (Time- temperature Chart)<br><br>(f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).<br><br>(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.<br><br>(h.) Certificate of Conformance (COC) wherever applicable.<br><br>(i.) MDCC |
| 23.03.00 | Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system. |
| 23.04.00 | Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.<br><br>(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.<br><br>(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.<br><br>(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 23.05.00 | **TRANSMISSION OF QA DOCUMENTATION**<br><br>On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.<br><br>For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment. |
| 24.00.00 | **PROJECT MANAGER'S SUPERVISION** |
| 24.01.00 | To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision. |
| 24.02.00 | The work shall be performed under the supervision of the Project Manager.<br><br>The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:<br><br>(a.) Interpretation of all the terms and conditions of these documents and specifications:<br><br>(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc:<br><br>(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :<br><br>(d.) Inspect, accept or reject any equipment, material and work under the contract :<br><br>(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates<br><br>(f.) Review and suggest modifications and improvement in completion schedules from time to time, and<br><br>(g.) Supervise Quality Assurance Programme implementation at all stages of the works. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 25.00.00 | **INSPECTION, TESTING AND INSPECTION CERTIFICATES** |
| 25.01.00 | The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection. |
| 25.02.00 | The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. |
| 25.03.00 | The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies. |
| 25.04.00 | The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract. |
| 25.05.00 | When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract. |
| 25.06.00 | In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing. |
| 25.07.00 | The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract. |
| 25.08.00 | To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month. |
| 25.09.00 | All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector. |
| 25.10.00 | **Associated document for Quality Assurance programme** |
| 25.10.01 | Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at **Annexure-I.** |
| 25.10.02 | Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at **Annexure-II.** |
| 25.10.03 | List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).** |
| 25.10.04 | Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.** |
| 25.10.05 | Field Welding Schedule Format enclosed at **Annexure-V.** |
| 25.11.00 | **TESTING OF MAJOR DESIGN FEATURES:** |
| | The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|

configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following.

a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B.

b) Loop reaction time for sample loops/ logics.

c) SOE functionality tests.

d) Server changeover.

e) Various response times, having serious implication on operation & maintenance philosophy.

f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load.

g) Unified HMI for DDCMIS.

The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer.

**If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.**

25.12.00 **DEMONSTRATION OF APPLICATION ENGINEERING**

25.12.01 Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system ( Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.

(i) Logics/Loops:

a) Drive logics implementation for each type of binary drive along with its display in HMI.

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA.<br><br>ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA.<br><br>iii) Mill noise which will be limited to 85-90 dBA.<br><br>iv) TG unit in which case it shall not exceed 90 dBA.<br><br>v) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA.<br><br>vi) For BFP Motor Noise level shall be with in the limit of 90 dBA. |
| 31.00.00 | **PACKAGING AND TRANSPORTATION**<br><br>All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation. |
| 32.00.00 | **ELECTRICAL EQUIPMENTS/ENCLOSURES** |
| 32.01.00 | All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications. |
| 33.00.00 | **INSTRUMENTATION AND CONTROL**<br><br>All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications. |
| 33.01.00 | All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|

All scales and charts shall be calibrated and printed in Metric Units as follows:

| | | | |
|---|---|---|---|
| 1 | Temperature | - | Degree centigrade (deg C) |
| 2. | Pressure | - | Kilograms per square centimetre ($Kg/cm^2$). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure. |
| 3. | Draught | - | Millimetres of water column (mm wc). |
| 4. | Vacuum | - | Millimeters of mercury gauge (mm Hg) or water column (mm Wcl). |
| 5. | Flow (Gas) | - | Tonnes/ hour |
| 6. | Flow (Steam) | - | Tonnes/ hour |
| 7. | Flow (Liquid) | - | Tonnes / hour |
| 8. | Flow base | - | 760 mm Hg. 15 deg.C |
| 9. | Density | - | Grams per cubic centimetre. |

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

33.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| 35.00.00 | **SURGE PROTECTION FOR SOLID STATE EQUIPMENT**<br><br>All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder. |
| 36.00.00 | **INSTRUMENT AIR SYSTEM**<br><br>The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.<br><br>Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve. |
| 37.00.00 | **TAPPING POINTS FOR MEASUREMENTS**<br><br>Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.<br><br>For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.<br><br>The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.<br><br>i) Temperature test pockets with stub and thermowell<br><br>ii) Pressure test pockets |
| 38.00.00 | **SYSTEM DOCUMENTATION**<br><br>The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|
| | documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.<br><br>The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage. |
| 38.01.00 | Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer. |
| 39.00.00 | **MAINTENANCE MANUALS OF ELECTRONIC MODULES**<br><br>The Contractor shall have to furnish two(2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him.The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS |
|---|---|

## LIST OF CODES AND STANDARDS

| Indian Standards | Title | International and Internationally recognised standards |
|---|---|---|
| IS:277 | Galvanised steel sheets (plain or corrugated) | |
| IS:655 | Specification for metal air duct | |
| IS:800 | Code of practice for use of structural steel in general building construction | BS 449:1969<br>BS 5950<br>ASA A57, 1-1952 |
| IS:807 | Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists<br>6588 (Issued by Standards Associa-tion of Australia).<br>DIN 120:1936 (Sheet 1)<br>DIN 120:1936 (Sheet 2)<br>327 part-I, 1951<br>BS 466 part-II, 1960<br>BS 644:1960<br>BS 1757:1951<br>BS 2573:part-I:1960 | Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev |
| IS:875 | Code of practice for design loads (other than earthquake) for buildings and structures<br>Leading standards (issued by Canadian Standard)<br>DIN-1055-1955<br>(Issued by ASA) | National Building code of Canada (1953)-Part-IV<br><br>Design section 4.1 |
| IS:1239 Part-I | Mild steel tubes | (ISO/R 65-1957)<br>(ISO/R-64-1958) |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| | | (ISO/R-65-1958)<br>(BS 1387 : 1957) |
| IS:1239<br>Part-II | Mild steel tubulars and other wrought steel pipe fittings | BS 1387 : 1967<br>BS 1387 :1967<br>BS 1740 :1965 |
| IS:2825 | Code for unfired vessels | |
| IS:1520 | Horizontal centrifugal pumps for clear cold and fresh water | |
| IS:1600 | Code for practice for performance of constant speed IC Engines for general purpose | |
| IS:1601 | Specification for perform-ance of constant speed IC Engines for general Purpose | |
| IS:1893 | Criteria for earthquake resistant design of structures | |
| IS1978-1971 | Line Pipe<br>April 1969. | API Standards 5L |
| IS:2254-1970 | Dimensions of vertical shaft motor for pumps | IEC Pub 72-1 part I<br>NEMA Pub MG 1<br>1954 |
| IS:2266 | Steel wire ropes for general engineering purposes | BS :302 : 1968 |
| IS:2312 | Propellant type Ventilation fans | |
| IS:2365 | Steel wire suspension ropes for lifts and hoists | BS : 1957 |
| IS:3346 | Method for the determin-ation of thermal | DIN 52612 (Deutscher Normenausschuss) |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| | | conductivity of thermal insulation materials (two slab guarded hot plate method) | ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963 |
| | IS:3354 | Outline dimensions for electric lifts. | |
| | IS:3401 | Silica gel | |
| | IS:3588 | Specification for electrical axial flow fans | |
| | IS:3589 | Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre) | |
| | IS:3677 | Unbonded rock and slag wool for thermal insulation | |
| | IS:3815 | Point hook with shank for general engineering purposes | BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS) |
| | IS:3895 | Specification for monocry-stallines semiconductor rectifier cells and stacks | |
| | IS:3963 | Roof extractor unit | |
| | IS:3975 | Mild steel wires, strips and tapes for armouring cables | |
| | IS:4503 | Shell and tube type heat Exchanger | |
| | IS:4540 | Specification for monory-stallines rectifire assembly | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| | equipment | | |
| IS:4671 | Expanded polystyrene for thermal insulation purpose | | |
| IS:4736 | Hot dip zinc coating on steel tubes | | |
| IS:4894 | Centrifugal fans | | |
| IS:5456 | Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only) | | |
| IS:5749 | Forged ramshorn hooks | Entwurf DIN 15402 Blett 1<br>Entwurf DIN 15402<br>BS 3017-1958 | |
| IS:6392 | Steel pipe flanges | BS 4504 : 1969 | |
| IS:6524 Part-I | Code of practice for design of tower cranes Static and rail mounted | BS 2799 : 1956 | |
| IS:7098 | Cross linked Polyethylene insulated PVC sheathed cables | Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524 | |
| IS:7373 | Specification for wrought aluminium and aluminium sheet and strips | | |
| IS:7938 | Air receivers for compressed air installation | | |
| ISO:1217 | Displacement compressor-Acceplance test | | |
| ASHRAE-33 and air heating coils. | Methods of testing for rating of forced circulation air cooling | | |
| ASHRAE-52-76 particle matter. | Air cleaning device used in general ventilation for removing | | |

| | |
|---|---|
| ASHRAE-22-72 | Method of testing for rating of water cooled refrigerant condensers. |
| ASHRAE 23-67 | Methods of testing for rating of positive displacement refrigerant compressors. |
| ARI-450-6 | Standard for water cooled refrigerant condensers. |
| ARI-550 | Standard for centrifugal water chilling packages. |
| ARI-410 | Standard for forced circulation air cooling and air heating coils |
| ARI-430/435 | Central station AHU/Application of Central Station AHU |
| BS:848 (Part-1,2) | Fans |
| BS:400 | Low carbon steel cylinders for the storage & transport of permanent gases. |
| BS:401 | Low carbon steel cylinders for the storage & transport of liquified gases. |
| CTI Code ACT-105 | Acceptance test code for Water Cooling Tower. |
| ANSI-31.5 | Refrigerant piping |
| ASME-PTC-23-1958 | Atmospheric Water Cooling Equipment |
| AMCA A-21C | Test Code for air moving devices |
| API:618 | Reciprocating Compressor for general refinary services. |

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**Miscellaneous**

| | |
|---|---|
| IS:802 | Code of practice for use of structural steel in |
| (Relevant parts) | overhead transmission line towers. |
| IS:803 | Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. |
| IS:10430 | Creteria for design of lined canals and liner for selection of type of lining. |
| IS:11592 | Code of practice for selection and design of belt conveyors. |
| IS:12867 | PVC handrails covers. |
| CIRIA | Design and construction of buried thin-wall pipes. |
| Publication | |

**REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION**

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

**Temperature Measurements**

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

**Pressure Measurements**

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).
   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**Flow Measurements**

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

**Electronic Measuring Instrument & Control Hardware/ Software**

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).
5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.
6. Printed circuit boards - IPC TM - 650, IEC 326 C.
7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).
11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).
12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.
13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.
14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.
15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

**Instrument Switches and Contact**

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.

2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

**Enclosures**

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).

2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).

3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

**Apparatus, enclosures and installation practices in hazardous area**

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.

2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.

3. Instrinsically safe apparatus - NFPA 493 1978.

4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.

5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| S.No | Description of Drgs/Docs | No of Prints | No of CD ROMs/DVDs/Portable Hard Disk |
|---|---|---|---|
| 1 | Drawings, Data sheets, Design calculations, Purchase specifications and other documents | | |
| | First submission and submission with major changes | | |
| | ▪ Layout (A0&A1 sizes) | 4 | - |
| | ▪ Other Drawings/Documents (A0&A1 sizes) | 2 | - |
| | ▪ P&ID (All sizes) | 4 | - |
| | a) Final drawings/documents (Directly to site) | 6 | 2 |
| | b) "As Built" Drawing/Documents (Directly to site) | 6 | 2 |
| | c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications. | 2 | 2 |
| 2 | Erection Manual (Directly to site) | 4 sets | 2 |
| 3 | Operation & Maintenance manual<br>i) First Submission | 1 set | -- |
| | ii) Final Submission (Directly to site) | 4 sets | 2 |
| 4 | Plant Hand Book<br>i) First Submission | 1 | 1 |
| 5 | Commissioning and Performance Test Procedure manual<br>i) First Submission | 1 set | -- |
| | ii) Final Submission (Directly to site) | 4 sets | 2 |

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS (Annexure-VI) |
|---|---|

| S.No | Description of Drgs/Docs | No of Prints | No of CD ROMs/DVDs/Portable Hard Disk |
|---|---|---|---|
| 6 | Performance and Functional Guarantee Test Report<br>i) First Submission | 2 sets | -- |
| | ii) Approved Copies (Direct to Site) | 4 sets | 2 |
| 7 | Project Completion Report (Directly to site) | 6 sets | 2 |
| 8 | QA programme including Organisation for implementation and QA system manual(with revisions) | 1 | -- |
| 9 | Vendor details in respect of proposed vendors including contractor's evaluation report. | 2 | -- |
| 10 | Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc<br>i) For review/comment | 1 | -- |
| | ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site) | 4 | 2 |
| 11 | Welding Manual, Heat Treatment Manuals, Storage & preservation manuals<br>i) For review/comment | 1 set | -- |
| | ii) Approved copies (Direct to Site) | 4 sets | 2 |
| 12 | QA Documentation Package for items / equipment manufactured and despatched to site | 2 sets | 2 |
| 13 | QA Documentation Package for field activities on equipment/systems at site | 2 sets | 2 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB-SECTION–IV

# FUNCTIONAL GUARANTEES

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS**

The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

The term “BMCR” (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator (as defined Cl. No. 1.02.00 Sub-section A-02, Part-B) at super heater outlet at rated parameters.

The term “TMCR” (Turbine maximum continuous rating) appearing in the technical specification shall mean 800 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under rated steam parameters, 0% cycle make-up and 160 mmHg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure and /or a different throttle steam pressure.

1.00.00 **PERFORMANCE GUARANTEES**

1.00.01 **General Requirements**

a) The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.

b) The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

c) The Contractor shall conduct performance test and demonstrate all the guarantees covered herein, during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.

d) All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation, shall be included in the bid price.

e) It is the responsibility of the contractor to perform the Performance

Guarantee/Acceptance test as specified in this subsection. The performance tests will be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall only be used for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

f) The Contractor shall make the plant ready for the performance guarantee tests.

g) All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be supplied by the contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

h) Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost.

i) The Performance / Acceptance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award. After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one months from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.

The P&G test procedures shall be submitted for equipments/ system & subsystem under Contractor's scope for all Guarantees under category I, II & III as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.

j) The contractor shall submit for Employer’s approval the detailed Performance Test procedure containing the following:

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

a) Object of the test.

b) Various guaranteed parameters & tests as per contract.

c) Method of conductance of test and test code.

d) Duration of test, frequency of readings & number of test runs.

e) Method of calculation.

f) Correction curves.

g) Instrument list consisting of range, accuracy, least count, and location of instruments.

h) Scheme showing measurement points.

i) Sample calculation.

j) Acceptance criteria.

k) Any other information required for conducting the test.

k) In case during performance guarantee tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified at clause 1.01.02 of this subsection, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 1.01.02 of this sub-section. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

**i) For Category-I Guarantees**

Reject the equipment/system/plant and recover from the Contractor the payments already made

OR



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

Refer GPC format Annexure-IV, for more details

Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called `Category - I' Guarantees.

**ii) For Category-II Guarantees**

Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees. Conformance to the performance requirements under Category -II is mandatory.

**iii) For Category-III Guarantees**

Reject the equipment / system/plant & recover from the Contractor the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s) replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters/capacities shall be termed as category - III, guarantees.

1.01.00 **GUARANTEES UNDER CATEGORY - I**

1.01.01 The performance guarantees which attract liquidated damages (LD) are as follows:

**i) Unit Heat Rate**

a) Unit Heat rate in kcal/kWhr under rated steam conditions at **160 mm Hg (abs) condenser pressure** with zero (0%) make up at 800 MW unit load (i.e. 100% of rated load).

(b) Unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 210 Kg/cm2 (abs) and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 600 deg C at 160 mm Hg (abs) condenser pressure with zero make up at 600 MW unit load (i.e. 75% of rated load) .

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB-SECTION–E-04

# FGD SYSTEM

BIDDER(S) TO CONSIDER FOR THE ITEMS IN THEIR SCOPE FOR THE GYPSUM DEWATERING SYSTEM, AS APPLICABLE

| CLAUSE NO. | QUALITY ASSURANCE |
|---|---|

## FLUE GAS DESULPHURISATION SYSTEM

**1.00.0 FLUE GAS DESULPHURISATION SYSTEM**

**1.01.0 Mills:**

1.01.01 Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness.

1.01.02 Wear-resistant parts shall be UT/RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out.

1.01.03 Butt welds in the tube/separator/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced.

1.01.04 All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed.

**1.02.0 Feeders:**

1.02.01 Any welds in the casing/pulley fabrication shall be checked with MPI.

1.02.02 Routine tests shall be done as per relevant Indian Standards or equivalent International Standards.

1.02.03 All major items like plates for casing, head pulley, tail pulley, pulley shaft and major castings shall be procured with respective material test certificates.

1.02.04 Calibration check shall be carried out on all feeders.

**1.03.0 Dampers:**

1.03.01 All the dampers shall be subjected to operational test/checks.

1.03.02 Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness as per NTPC Tech Specification.

**1.04.0 PIPING, VALVE AND SPECIALITIES:**

1.04.01 All pipes and fittings shall be tested as per applicable code.

1.04.02 All valves shall be hydraulically/Air tested for body, seat and back-seat (if applicable) as per relevant standard.

1.04.03 NDT on valves shall be as per relevant standard.

1.04.04 Valves shall be offered for hydro test in unpainted conditions.

1.04.05 Functional checks of the valves for smooth opening and closing shall also be done.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | QUALITY ASSURANCE |
|---|---|

**1.05.00** **TANKS / VESSELS:**

**1.05.01** **Atmospheric tanks:**

i) All welds joints shall be DP tested and complete tanks shall be water fill tested.
ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code as applicable.
iii) Rubber lining shall be tested for hardness and spark test, as applicable.

**1.05.02** **Pressure vessels:**

1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:

   i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.
   ii) 10% DPT on all finished butt welds.
   iii) 10% RT (covering all 'T'/cross joints) of butt welds.

2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

**1.06.00** **HEAT EXCHANGER/HEATER:**

1.06.01 All material shall be tested for chemical and mechanical properties and NDT as per relevant standard.

1.06.02 NDT on welds and other checks shall be as per relevant code.

1.06.03 Air heaters shall be subjected to dimensional and clearance checks as per standard practice

1.06.04 Lub. oil system, drive system, soot blowing system etc. of Air heaters shall be checked suitably as per standard practice

**1.07.00** **PUMPS:**

1.07.01 UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.

1.07.02 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.

1.07.03 The pump rotating parts shall be subjected to static and dynamic balancing.

1.07.04 All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.

1.07.05 Noise and vibration shall be measured during the performance testing at shop.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | QUALITY ASSURANCE |
|---|---|
| **1.08.00** | **STRUCTURES , DUCTS, HOPPERS:** |
| 1.08.01 | All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested. |
| 1.08.02 | Visual inspection of all welds shall be performed in accordance with AWSD1.1. |
| 1.08.03 | NDT requirements of structural steel welds shall be as under:<br>i) 100% RT/UT on butt-welds of plate thickness>= 32mm.<br>ii) For plates of 25mm<=thickness<32mm-10% RT and 100% MPI.<br>iii) For plates of thickness <25mm-10% MPI/LPI. |
| 1.08.04 | Edge for shop and field weld shall be examined by MPI for plate thickness >= 32mm. |
| **1.09.00** | **VACUUM BELT FILTER SYSTEM:** |
| 1.09.01 | Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested. |
| 1.09.02 | UT on shaft (if greater or equal to 40mm) and impeller shall be carried out. |
| 1.09.03 | All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc. |
| 1.09.04 | Filter cloths and belts shall be tested for physical properties as per relevant standard |
| 1.09.05 | Hydro cyclones shall be checked by visual, dimensional etc. |
| **1.10.00** | **SPRAY NOZZLES:** |
| 1.10.01 | Spray nozzles shall be tested for physical properties |
| 1.10.02 | Spray nozzles also shall be subjected to performance test. |
| **1.11.00** | **AGITATORS:** |
| 1.11.01 | Rubber lining shall be tested for hardness and spark test |
| 1.11.02 | Impellers shall be tested for dimensional and balancing check |
| 1.11.03 | Gear Boxes shall be tested for run test as per standard practice |
| **1.12.00** | **FANS:** |
| 1.12.01 | Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining. |
| 1.12.02 | Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

1.12.03 All rotating components and assemblies of fan shall be balanced dynamically

1.12.04 Performance test shall be carried out on fans as per Technical specification/ Relevant standard

1.12.05 Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard

**1.13.00 Thermal Insulation, Lagging & Cladding:**

(a) **Lightly resin bonded mineral wool:**

LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries.

(b) **Lagging & Cladding:**

All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.

**1.14.00 OTHER CRITICAL EQUIPMENTS:**

1.14.01 Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

SPECIFICATION No: PE-TS-434-571-A001
SECTION : I
SUB-SECTION : C2-B
REV 01
Painting (Customer Specification)

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB – SECTION – A-12

# SURFACE PREPARATION & PAINTING

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **1.00.00** | **SPECIFICATION OF SURFACE PREPARATION & PAINTING** |
| **1.01.00** | Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material. |
| **1.02.00** | All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour. |
| **1.03.00** | Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces. |
| **1.04.00** | All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering. |
| **1.05.00** | **SURFACE PREPARATION** |
| 1.05.01 | All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents. |
| 1.05.02 | The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.<br>SP1 Solvent cleaning<br>SP2 Application of rust converter (Ruskil or equivalent grade)<br>SP3 Power tool cleaning<br>SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)<br>SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns<br>SP5 Shot blasting/ abrasive blasting.<br>SP6 Emery sheet cleaning/Manual wire brush cleaning. |
| **1.06.00** | **APPLICATION OF PRIMER/PAINT** |
| **1.06.01** | The paint/primer manuacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein. |
| **1.06.02** | Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces. |
| **1.06.03** | Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats. |
| **1.06.04** | Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected.Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured. |
| **1.06.05** | Following are the Primer/painting schemes envisaged herein:<br>PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.<br>PS3* - Zinc Chrome primer (Alkyd base) by dip coat.<br>PS4 - Synthetic Enamel (long oil alkyd) to IS2932.<br>PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744<br>PS9 - Aluminium paint to IS 2339.<br>PS9* - Heat resistant Aluminium paint to IS-13183 Gr.-1<br>PS13 - Rust preventive fluid by spray, dip or brush.<br>PS14 - weldable primer-Deoxaluminate or equivalent.<br>PS16 - High Build Epoxy CDC mastic `15' .<br>PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.)<br>PS18 - Epoxy based TiO2 pigmented coat<br>PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=40.0(min.)<br>PS-20 - Epoxy based finish paint |
| **1.06.06** | All weld edge preparation for site welding shall be applied with one coat of wieldable primer. |
| **1.06.07** | For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies. |
| **1.06.08** | SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection. |
| **1.06.09** | a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron.<br>The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner:<br>▪ Primer coat – Epoxy based zinc phosphate<br>▪ Intermediate - Epoxy based TiO2 pigmented coat<br>▪ Finish coat - Epoxy based finish coat<br>b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron.<br>c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**1.06.10**

A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows:

Primer : One coat of unmodified epoxy resin along with polymide hardener.

Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener.

Total thickness of primer and paint should not be less than 400 microns.

B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows:

i) For Indoor vessel, tanks, piping, valves & other equipments:

(a) Surface preparation shall be done either manually or by any other approved method.

(b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns.

(c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns.

(d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns.

Total DFT of paint system shall not be less than 150 microns.

ii) For Outdoor vessel, tanks, piping, valves & other equipments:

(a Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard.

(b Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.

(c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.

(d Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied.

Total DFT shall not be less than 300 microns.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

| **F) FGD System** |
|---|
| (i) Surface preparation shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard.<br>(ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.<br>(iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.<br>(iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat *of* polyurethane of minimum DFT of 25 microns shall be provided. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev. 01

This is part of Technical Specification No. PE-TS-424-571-A001, Rev. 01

| | | | |
|---|---|---|---|
| RANIPET | **Bharat Heavy Electricals Limited**<br>**Boiler Auxiliaries Plant**<br>**Ranipet – 632 406** | **BHEL DOC NO.** | **PS : PATR :FGD: R4R3-R4S4** |
| | | **REVISION NO.** | **07** |
| | | **DATE** | **25.11.2019** |

# PATRATU STPP FGD PACKAGE

## PAINTING SCHEME for FGD SYSTEM, GATES& DAMPERS

## NTPC CONTRACT NO: 01/PVUNL-CS-9585-001-2/N0A-SC

## *NTPC DRG NO: 9585-001-109-PVM-H-001*

## BHEL RANIPET Customer No(s).: R4R3, R4S3-R4S4

| Prepared By | Reviewed & Approved By |
|---|---|
| **Rajamanickam M**<br>**Dy. Mgr/QA** | **K.C.** |

Certification signature by Niraj Krishna <nirajkrishna@ntpc.co.in> Validity Unknown
Digitally signed by Niraj Krishna
Date: 2019.12.04 15:40:05 IST
Reason: CAT I
Location: NTPCEOC

619031/2021/PS-PEM-MAX

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## RECORD OF REVISION

| REV NO | DATE | DETAILS OF REVISION |
|---|---|---|
| 00 | 25.08.2018 | Original Issue - First Submission |
| 01 | 06.12.2018 | Revised Issue<br>**NTPC comments:** This document can be reviewed in totality after receipt of inputs on FGD system. Any equipment detail and any missing equipment can be reviewed only after receiving of basic drawings of FGD system<br>**BHEL reply:** We wish to submit that the painting scheme was prepared after taking all the inputs from Engg in the form of PGMA release. Hence there will not be any equipment missed. Also Engg has confirmed that it has started the submission of basic documents. |
| | | **NTPC comments:** Sl no: 09 of FGD, what all items are covered under emergency quench system? Kindly mention here<br>**BHEL reply:** Items covered under the emergency quench system are mentioned in the PGMA details at the end of the document. |
| | | **NTPC comments:** Sl no: 10 of FGD, kindly include details of items covered under air oxidation system<br>**BHEL reply:** Items covered under air oxidation system are mentioned in the PGMA details at the end of the document. |
| | | **NTPC comments:** Sl no: 11 of FGD, kindly include details of items covered under oxidation air distribution system<br>**BHEL reply:** Items covered under the oxidation air distribution system are mentioned in the PGMA details at the end of the document. |
| | | **NTPC comments:** Sl no: 12 of FGD, Description not clear. Kindly give detail & Indicate temperature& Primer paint<br>**BHEL reply:** Expansion joint comes in the bypass ducts. It is of straight pieces without any round corner joints. It is of metallic in construction. The items covered in the PGMA are mentioned in the PGMA details at the end of the document. Temperature and primer paint is changed as per comments and finish paint is incorporated. |
| | | **NTPC comments:** Sl no: 13 of FGD, Description not clear. Kindly give detail& indicate temperature & primer paint<br>**BHEL reply:** Expansion joints between scrubbers comes in the absorber region. It is of non-metallic in construction. The reason for giving painting is that items like flanges and sleeves are envisaged in this PGMA, hence painting is given. Temperature is indicated in the document. Primer paint is changed as per comments and finish paint incorporated. |
| | | **NTPC comments:** Sl no: 14&15 of FGD, Indicate temperature ad primer and finish paints<br>**BHEL reply:** Temperature, Primer and finish paints are incorporated in the document. |
| | | **NTPC comments:** Sl no: 16, 17, 19, 23, 29,30,34, 37 of FGD, comments on paints<br>**BHEL reply:** Comments on paints are incorporated in all the above sl nos. Also since as per spec for civil works, finish coat of 70 microns only specified, hence finish DFT of 70µ and Total DFT of 245µ is indicated. |
| | | **NTPC comments:** Sl no: 21, 27, 32 of FGD, Furnish details<br>**BHEL reply:** Details of all PGMA's are mentioned at the end of the document. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT / DFT (µm min.) | PAINT | DFT (µm min.) | |

| | | |
|---|---|---|
| 02 | 11.01.2019 | **NTPC comments:** Sl no: 4& 5 Give details surface finish and primer on inside surfaces<br>**BHEL reply:** Incorporated in the document. |
| | | **NTPC comments:** PHC, SHC & Vacuum Belt Filter related items to be covered.<br>**BHEL reply:** Incorporated in the document. |
| | | **NTPC comments:** Blower with motor, is it seal air fan, kindly give basis for painting of this item; Motor paint will be RAL 5012.<br>**BHEL reply:** It is seal air fan as it supplies seal air. Motor paint shade will be RAL 5012 only which will be indicated by the electrical group in the drawing. The basis for selecting the paint is as per Sub- Section A-12, B) Steam generator and Auxiliaries and Clause 20.03.00 of Part- C Section VI. Since it is under auxiliaries, we have chosen this painting. Also the surfaces are less than 95°C. Hence we request you to retain the same painting specification. |
| | | **NTPC comments:** Furnish paint details of major electrical equipment like motors, Transformers, bus duct, MCC & control panels, cable trays etc<br>**BHEL reply:** Electrical items are bought out items and therefore the painting specification will be given by respective Engg group as per the tender specification in the drawing itself which will submitted to NTPC for approval. Therefore, the painting of electrical items is not covered under this painting scheme. This is the practice which is being followed for Auxiliaries as well. Also we would like to state that same comment was given for Dadri FGD painting scheme and the above reply was also accepted by M/s NTPC. We request you to kindly accept our explanation and accord approval. |
| | | **NTPC comments:** Please include the surface coating and painting details for individual equipment of LHP/GHP<br>**BHEL reply:** We would like to state that scope of LHP, Limestone handling plant and GHP, Gypsum handling plant lies with BHEL, ISG, Bangalore. They will be submitting the separate painting scheme for the LHP and GHP. Also we would like to inform that all items pertaining to Ranipet scope of supply has been included in this painting scheme. We request you to kindly approve the painting scheme. |
| 03 | 30.01.2019 | **NTPC comments:** The same has to be ensured and taken care in the respective equipment drgs.<br>**BHEL reply:** BHEL will ensure the same in the respective equipment drawings. |
| | | **NTPC comments**: Sl no: 5& 7 of FGD, Inorganic ethyl zinc silicate primer to be applied as per spec requirement as proposed for all other items.<br>**BHEL reply:** Incorporated in the document. |
| | | **NTPC comments**: Sl no: 24 of FGD, ~~Other Items- Blast cleaning~~<br>**BHEL reply:** Incorporated in the document. |
| | | **NTPC comments**: Please clarify whether SS lining is all around the cylindrical and conical portion of silo?<br>The inside painting of silo where SS lining is not provided shall be as per structural steel painting scheme<br>**BHEL reply:** SS lining is all around the conical portion of silo. For cylindrical portion- inside painting, primer as given for structural steel painting scheme is incorporated in the document. |
| | | **NTPC comments:** Sl no: 39 to 41, Painting scheme to be followed as per (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9) in line with other FGD components. Details of related items to be included in the list.<br>**BHEL reply:** Incorporated in the document. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) |

| | | |
|---|---|---|
| 03 | 30.01.2019 | **NTPC comments:** Sl no: 03 of Painting scheme to be followed as per (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9) in line with other FGD components. Motor paint RAL 5012<br>**BHEL reply:** We wish to state that the referred item is coming under gates and dampers which is part of auxiliaries and therefore painting under Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9 is considered. Also these components are sub-items to the main component. Hence we request you to accept the painting as mentioned under above spec. |
| | | **NTPC comments:** Note 11 to be incorporated<br>**BHEL reply:** Note incorporated in the document. |
| 04 | 18.02.2019 | **NTPC comments:** Inside surface painting on silo (cylindrical portion) shall be as per outside surface painting scheme of Limestone silo<br>**BHEL reply:** We wish to state that the painting envisaged is until erection only. Once the system is commissioned, paint will peel off completely and application of intermediate and finish paints will become redundant, therefore we have proposed only primer. Also primer given is of Inorganic Zinc silicate which offers superior protection against corrosion, abrasion and chemical resistance. Hence we request you to kindly consider and approve the painting envisaged. |
| | | **NTPC comments:** Blast cleaning to be done. Is there any liner provided on mill inside surface? Inorganic ethyl zinc silicate primer to be applied as per spec requirement as proposed for all other items.<br>**BHEL reply:** Blast cleaning is incorporated in the document. We wish to state that rubber liner is provided on the mill inside surface as per the specification. Primer paint of Epoxy zinc phosphate primer is envisaged as per the spec requirement vide clause **Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9**. We request you to kindly accept our proposed painting and approve our document. |
| 05 | 05.03.2019 | **NTPC comments:** As commented earlier, all painting coats on inside surface of silo (cylindrical portion) shall be same as per outside surface painting scheme of Limestone silo.<br>**BHEL reply:** Based on NTPC directive, we have incorporated in the document. Kindly approve the document. |
| 06 | 25.10.2019 | **Revised Issue-** New PGMAs added under FGD system and Engg has deleted some PGMAs too as they have been amalgamated, hence addition & deletion of new PGMAs done under Sl nos: 2,3,5,7,11,13,15,20, 21,22, 23, 24, 28,29, 30, 34, 35, 36, 37, 38, 40, 41, 42, 46, 47& 48 under FGD and resubmitted for your kind approval. There is no change in the painting scheme, only the PGMAs are added/deleted under the above mentioned Sl nos. We request you to kindly review and approve our painting scheme. |
| 07 | 25.11.2019 | **NTPC comments**: Sl no: 18 of FGD, earlier painting scheme as per S.N. 17 (PGMA 257) is different.<br>**BHEL reply**: We wish to submit that the painting for PGMA 257 is same only. The commented Sl no is Sl no: 18 which is of duct structures hence painting as per Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03 is given. |
| | | **NTPC comments**: Miscellaneous FGD system removed in this revision? Limestone silo accessories missing in this revision.<br>**BHEL reply:** We wish to submit that our Engg has removed this PGMA as they have added the items under new PGMAs for which painting is given in Sl no: 30 of this painting scheme. (FW 725 is Nozzles and Flanges which are Miscellaneous FGD items and FW 723& 724 are limestone silo accessories). We also wish to add that there is no change in the painting specification. Since many of the PGMAs are added and some are deleted, we have gone for this resubmission of the painting scheme. We request you to kindly approve the painting scheme. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) |
| | | | **NTPC comments:** PHC & SHC and accessories structural items missing in this revision.<br>**BHEL reply:** Our Engg has amalgamated these PGMAs with FW 738 PGMA (Gypsum Belt filter and accessories). Hence those PGMAs are removed from the painting scheme. We wish to add that there is no change in the painting specification and same painting specification is only retained. We request you to kindly approve the painting scheme. | | | | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | **1. FGD SYSTEM** | | | | | | | |
| 1 | Slurry recirculation pump System **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 212 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Light Blue, RAL 5012 | 75<br>25 | 300 |
| 2 | Absorber System Internals – Structural items **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 213 | Blast cleaning to Sa 2½ | **Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002 | 75<br>25 | 300 |
| 3 | Mist eliminator and accessories, Absorber baffle grating support, Mist eliminator support& Absorber Spray pipe support - Structural items **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 215<br>FW 216<br>FW 217<br>FW 218 | Blast cleaning to Sa 2½ | **Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002 | 75<br>25 | 300 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) | |
| 4 | Absorber System- Base **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 219 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 5 | Absorber system structures, Absorber shear plate, Hook up duct structure **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 220 FW 231 FW 238 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 6 | Absorber system casing bottom **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)**<br><br>Inside surfaces of Absorber casing top& bottom is lined with C-276 material, hence no paint is envisaged. | FW 221 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 7 | Absorber system casing top, Duct supports & Structures for RC pump house **(Tec. Spec. Sec.VI, Part-B, Subsection- D-01, cl. 6.04.03)** | FW 222<br>FW 232<br>FW 234<br>FW 236 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 8 | Absorber system accessories **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 223 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based | 100<br><br>100 | **Finish**: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ | 75<br><br>25 | 300 |





619031/2021/PS-PEM-MAX

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | intermediate paint pigmented with MIO/Tio2<br>DFT- 100µ | | **Finish**: One coat of acrylic aliphatic polyurethane paint to IS 13213<br>DFT-25µ<br>Shade: Grey White, RAL 9002 | | |
| 9 | Emergency Quench water tank- Outside surfaces **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 226 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min))<br>DFT = 75 µm per coat (min.)<br>Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment))<br>DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat,<br>Shade: Grey white RAL9002 | 70 | 245 |
| 10 | Emergency Quench water tank- Inside surfaces | FW 226 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm | **Primer Coat:** Two coats of Red Oxide Zinc phosphate primer, DFT-30µ/coat; Total-60µ<br>(Primer is only envisaged as lining is given in inside surfaces of the tank)<br>DFT = 30 µm per coat; Total DFT- 60µ | | | | |





619031/2021/PS-PEM-MAX

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|---|
| 11 | Emergency quench system Handling Equipment RC pump **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | | FW 227 FW 249 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002 | 75<br>25 | 300 |
| 12 | Air oxidation system **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | | FW 230 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002 | 75<br>25 | 300 |
| 13 | Oxidation Air distribution system& Slurry distribution system, Absorber W/D interface and W/D wash system **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | | FW 228 FW 229 FW 243 FW 244 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Sky blue, Shade no.101 of IS:5 | 75<br>25 | 300 |
| 14 | Expansion joint between bypass | Flue gas swept surface (Inside) | FW 251 | Power Tool Cleaning to St3 (SSPC-SP3) | Red Oxide Zinc Phosphate Primer to IS: 12744 (two coats) | 60 | NIL | -- | 60 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|---|
| | **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9)** Temp>60°C | Insulated surfaces | | Power Tool Cleaning to St3 (SSPC-SP3) | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | 40 |
| 15 | Expansion joint between scrubbers **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9)** Temp>60°C | Flue gas swept surface (Inside) | FW 252 | Power Tool Cleaning to St3 (SSPC-SP3) | Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) | 60 | NIL | -- | 60 |
| | | Insulated surfaces | | Power Tool Cleaning to St3 (SSPC-SP3) | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | 40 |
| 16 | Ducts between bypass duct inlet& Absorber **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9)** Temp-150°C | Flue gas swept surface (Inside) | FW 255 | Power Tool Cleaning to St3 (SSPC-SP3) | Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) | 60 | NIL | -- | 60 |
| | | Insulated surfaces | | Power Tool Cleaning to St3 (SSPC-SP3) | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | 40 |





619031/2021/PS-PEM-MAX

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|---|
| 17 | Ducts between Absorber& Stack **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9)** Temp-60°C | Flue gas swept surface (Inside) | FW 257 | Power Tool Cleaning to St3 (SSPC-SP3) | Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) | 60 | NIL | -- | 60 |
| | | Insulated surfaces | | Power Tool Cleaning to St3 (SSPC-SP3) | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C) | 20 | 40 |
| 18 | Duct structure between by pass duct & Absorber **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | | FW 260 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 19 | Duct structure between Absorber & Stack **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 262 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 20 | Foundation material for duct structures, Absorber, RC shed,tanks, pipe racks& Silo Structure | FW 280<br>FW 281<br>FW 282<br>FW 283<br>FW 740<br>FW 760<br>FW 762<br>FW 763 | Temporary rust preventive fluid application as per PRQA 523<br>DFT- 20µ<br>All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents. | | | | | |
| 21 | Structures for Elevator& Supporting structures for Emergency Quench Water Tank<br>**(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 285<br>FW 292 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min))<br>DFT = 75 µm per coat (min.)<br>Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment))<br>DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 22 | Elevator and accessories<br>**(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 293<br>FW 716 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238<br>DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2<br>DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT-75µ<br><br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213<br>DFT-25µ<br>Shade: Grey white, Shade no. RAL 9002 | 75<br><br>25 | 300 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 23 | Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.08, 6.04.09)** | FW 237<br>FW 610<br>FW 612<br>FW 613<br>FW 722 | Gratings- Blast cleaning to Sa 2½ | Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (minimum) | | | | |
| 24 | Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks – Structures other than the above **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 237<br>FW 610<br>FW 612<br>FW 613<br>FW 722 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min))<br>DFT = 75 µm per coat (min.)<br>Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment))<br>DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat,<br>Shade: Grey white RAL9002 | 70 | 245 |
| 25 | Slurry pumps & accessories **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 701 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238<br>DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br><br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213<br>DFT-25µ | 75<br><br>25 | 300 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | intermediate paint pigmented with MIO/Tio2<br>DFT- 100µ | | Shade: Light Blue, RAL 5012 | | |
| 26 | Water pumps & accessories<br>**(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 702 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile<br>40 – 60 µm | **Primer**: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238<br>DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2<br>DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br><br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213<br>DFT-25µ<br>Shade: Light Blue, RAL 5012 | 75<br><br>25 | 300 |
| 27 | Monorail for hoist & cranes<br>**(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 710 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min))<br>DFT = 75 µm per coat (min.)<br>Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment))<br>DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat,<br>Shade: Grey white RAL9002 | 70 | 245 |
| 28 | Handling Equipment in FGD<br>**(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 713<br>FW 714 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile<br>40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238<br>DFT- 100µ<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2<br>DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213<br>DFT-25µ<br>Shade: Grey White, RAL 9002 | 75<br><br>25 | 300 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 29 | Man hole door & Viewing ports **(Tec. Spec Sec VI, Part B, Subsection A-12 Page 6 of 9)** | FW 239<br>FW 717 | Power Tool Cleaning to st3 (SSPC-SP3 | Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) | 60 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats) | 40 | 100 |
| 30 | Agitator support, Air cannon silo, Bag filter and fan assy silo and Nozzles and Flanges **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 721<br>FW 723<br>FW 724<br>FW 725 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br><br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002 | 75<br><br>25 | 300 |
| 31 | Limestone silo structures **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 730 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) | |
| 32 | Limestone Silo- Outside surfaces **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 731 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 33 | Lime stone Silo- Inside surfaces (Conical portion) | FW 731 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm conforming to ISO 8501-1 | **Primer:** Two coats of Red Oxide Zinc phosphate primer to IS: 12744<br><br>(SS lining is inside the Limestone silo conical portion, hence primer is only envisaged; SS lining will be done at shops itself) | 60 | NIL | -- | 60 |
| 34 | Lime stone Silo- Inside surfaces (Cylindrical portion) | FW 731 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 **Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 35 | Limestone silo approach platform, Platform for Pipe racks **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.08, 6.04.09)** | FW 733<br>FW 766<br>FW 767 | Gratings- Blast cleaning to Sa 2½; | Hand rails, Ladders, Gratings- Hot dip galvanizing to 610gms/sq. m (minimum) and to a coating thickness of 87µm (minimum) | | | | |
| 36 | Limestone silo approach platform, Pipe racks platform- Structures other than the above **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 733<br>FW 766<br>FW 767 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min))<br>DFT = 75 µm per coat (min.)<br>Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment))<br>DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat,<br>Shade: Grey white RAL9002 | 70 | 245 |
| 37 | Limestone Mill – Outside surfaces **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 735 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238<br>DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2<br>DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br><br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213<br>DFT-25µ<br>Shade: Grey White, RAL 9002 | 75<br><br>25 | 300 |
| 38 | Lime stone mill- Inside surfaces | FW 735 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer**: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238<br>DFT- 100µ | 100 | -- | -- | 100 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 39 | Gypsum belt filter and accessories Structural items **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 738 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br><br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br><br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002 | 75<br><br>25 | 300 |
| 40 | Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary Hydro-cyclone feed tank Outside surfaces **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 802 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 41 | Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary Hydro-cyclone feed tank Inside surfaces | FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749 FW 785 FW 786 FW 802 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm | Primer: Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (Lining is inside the tanks, hence primer is only envisaged for protection till erection) | 60 | NIL | -- | 60 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 42 | Process water pipe accessories, Cooling water pipe accessories **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)** | FW 751 FW 752 | Power Tool Cleaning to St3 (SSPC-SP3) | **Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel undercoat to IS: 2932 | 50 30 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sea Green Shade no: 217 as per IS 5 | 70 | 150 |
| 43 | Slurry pipe accessories **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)** | FW 753 | Power Tool Cleaning to St3 (SSPC-SP3) | **Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel undercoat to IS: 2932 | 50 30 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sea Green Shade no: 217 as per IS 5 | 70 | 150 |
| 44 | Service Air pipe accessories **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)** | FW 754 | Power Tool Cleaning to St3 (SSPC-SP3) | **Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel undercoat to IS: 2932 | 50 30 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5 | 70 | 150 |
| 45 | Instrument air pipe accessories **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)** | FW 755 | Power Tool Cleaning to St3 (SSPC-SP3) | **Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel undercoat to IS: 2932 | 50 30 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5 | 70 | 150 |
| 46 | All Valves and fittings (Temp <95 deg C) **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)** | FW 815 to FW 851 | Power Tool Cleaning to St3 (SSPC-SP3) | **Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel undercoat to IS: 2932 | 50 30 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat | 70 | 150 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| 47 | Structure for Pipe racks Trestle for pipe racks & Structures inside Gypsum dewatering building and Ball mill building **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)** | FW 761 FW 765 FW 768 FW 769 FW 787 | Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1 | **Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00<br><br>**Intermediate Coat:** One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min) | 75<br><br>100 | Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)<br><br>DFT = 35 µm per coat, Shade: Grey white RAL9002 | 70 | 245 |
| 48 | Supports for Cable trays, Tools, Air receivers, commissioning spares **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)** | FW 779 FW 798 FW 988 FW 996 FW 997 | Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm | **Primer:** One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ<br>**Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ | 100<br><br>100 | **Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ<br>**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002 | 75<br><br>25 | 300 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | **2-GATES & DAMPERS** | | | | | | | |
| 01 | **Gates & Dampers** > 95$^0$ C Insulated Surfaces& Uninsulated surfaces **(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9)** | 57 560<br>57 570<br>57 580<br>57 583 | Power Tool Cleaning to St3 (SSPC-SP3) | One coat of HR Aluminium paint to IS 13183 Gr. I | 20 | One coat of HR Aluminium paint to IS 13183 Gr. I | 20 | 40 |
| 02 | **Seal air piping (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)** | 57 141 | Power Tool Cleaning to St3 (SSPC-SP3) | **Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)<br>**Intermediate:** One coat of Synthetic Enamel undercoat to IS: 2932 | 50<br>30 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5 | 70 | 150 |
| 03 | **Blower with Motor Knife Gate valve (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9) & (Clause 20.03.00 of Part- C Section VI)** | 57 491<br>57 497 | Power Tool Cleaning to St3 (SSPC-SP3) | Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) | 60 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)<br>Motor paint Shade: RAL 5012 | 40 | 100 |
| 04 | Ladder, Cage for Ladder Toe Guard Plate Floor Grill, Hand Rails, Hand Rail Post **(Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.08, 6.04.09)** | 57 466 | Gratings- Blast cleaning to Sa 2½ | Hot Dip Galvanizing to 610 gm per sq. Meter (minimum) and to a coating thickness of 87 µm (minimum) | | | | |
| 05 | Other Structural Items- Other than sl.no. 4 of above& Mounting bracket | 57 209<br>57 466 | Power Tool Cleaning to St3 (SSPC-SP3) | Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) | 60 | Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats) | 40 | 100 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9) | | | | | | | |

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## 3. PAINTING OF DAMAGED AREAS

***Areas where paint has deteriorated badly by erosion and areas where the paint film has lost its adhesion property and where the steel has got rusted appreciably - these areas are to be repainted as per the following procedure:***

| SL NO | SURFACE LOCATION | SURFACE PREPARATION | PRIMER, INTERMEDIATE & FINISH |
|---|---|---|---|
| 1 | Paint damaged Components falling under FGD Sl no.01,02,03,04,05,06, 07,08,09,11,12,13,18 19,21,22,24,25,26,27,28,30,31,32,34,36, 37,39,40,47& 48 of FGD. | Hand/ Power Tool cleaning to Bare metal to minimum 6 inches peripheral area adjoining to damaged area | Primer: Epoxy Zinc rich primer to IS 14589, DFT-70µ (If Metal surface exposed) followed by intermediate & finish coat as per respective scheme<br>If primer is intact- Intermediate & finish as per respective scheme |
| 2 | Paint damaged components failing under other Sl nos of FGD & Gates & Dampers | Power Tool Cleaning to Bare metal | Primer and Finish : As given in respective scheme |

## GENERAL NOTES

1. No painting is required for Galvanized, non-ferrous & stainless steel items, except as indicated above.
2. Machined items are to be applied with coat of temporary rust preventive oil
3. PGMAs covered in sub-supplier (ie., Purchased) items viz., Agitator and other sub-delivery components etc., are not indicated in the above list. However, the Painting Schedule for all items supplied by all sub-suppliers and BOI under the scope of BHEL shall be same as for main equipment covered in this document.
4. In sub-assy, wherever plates / sheets of thickness less than or equal to 5mm and rods are used - Power Tool or Hand Tool Cleaning to SSPC - SP 3 / SP 2 shall be followed and painting shall be as per Sl no:05 of GAD.
5. Ground shade/colour of finish paints and identification tag/band for equipments, fans, piping, pipe services, supporting structures and other components is followed as per NTPC doc no: QS-01-DIV-W-4 at site.
6. All components covered under different PGMAs are to be painted. In case any component is left out, the same shall deemed to be included under the relevant section.
7. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves shall be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
8. Painting requirement for all electrical equipment shall be as per the details identified in specification for the respective equipment.
9. All steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of corrosivity category C3 (durability high) as per ISO 12944.
10. Finish coat to be applied after an interval of min 10 hrs and within 6 months (after completion of intermediate coat).
11. Bottom of base plate including below zero level portion marked in Supporting Columns of structures which will be embedded in concrete, those surfaces shall be prepared by manual cleaning to ST3 and provided with primer coat of chlorinated rubber based zinc phosphate primer of min. 50 µm DFT.

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

| SL NO | TYPE OF PAINT | SPECIFICATION OF PAINT | NO OF PACK | VOLUME OF SOLIDS (% Min) | MODE OF APPLICATION | MIN. OVER COATING INTERVAL (hours) | SHADE |
|---|---|---|---|---|---|---|---|
| 01 | Epoxy Zinc phosphate primer | IS 13238 | 2 | 40 | Spray | 24 | Grey |
| 02 | Zinc Ethyl silicate primer (% Zn on dry film= 80 (min)) | IS 14946 | 2 | 60 | Airless Spray only | 24 | Grey |
| 03 | Epoxy High solid-Polyamide cured Epoxy based MIO pigmented **intermediate coat** | -- | 2 | 80 | Airless Spray only | 16 | Brown |
| 04 | Epoxy based finish paint | IS 14209 | 2 | 62 | Airless Spray only | 16 | Corresponding shade no |
| 05 | Aliphatic isocyanate acrylic polyurethane paint | IS 13213 | 2 | 55 | Spray | 16 | Corresponding shade no |
| 06 | Heat resistant aluminium paint | IS 13183 Grade II | 1 | -- | Brush/ Spray | 24 | -- |
| 07 | Synthetic Enamel undercoat | IS 2932 | 1 | 40 | Brush/ Spray | 12 | -- |
| 08 | Long oil alkyd Synthetic enamel finish paint | IS 2932 | 1 | 35 | Brush/ Spray | 12 | Corresponding shade no |
| 09 | Red oxide Zinc phosphate primer | IS 12744 | 1 | -- | Brush/ spray | 12 | -- |

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**PGMA DETAILS**

| SNO | PGMA | PGMA DESCRIPTION | PGMA DETAILS |
|---|---|---|---|
| 01 | FW 212 | Slurry recirculation pump system | RC Pumps incl Shaft seal<br>Common Base Plate<br>Coupling and Guard<br>Gear Box<br>Expansion Bellow<br>Anchor Bolts & Fasteners<br>Special Tools |
| 02 | FW 219 | Absorber system base | Absorber tank bottom plate |
| 03 | FW 220 | Absorber system structures | Absorber tank structure<br>Absorber tower structure<br>Spray headers structure |
| 04 | FW 221 | Absorber system casing bottom | Absorber tank wall casing- bottom |
| 05 | FW 222 | Absorber system casing top | Absorber Tank wall casing –Top<br>Mist Eliminator supports<br>Spray pipe supports<br>Internal Beam<br>Shim plates in Absorber area<br>Internal Struts |
| 06 | FW 223 | Absorber system accessories | Nozzles and flanges<br>Inspection doors & Man holes<br>Viewing ports<br>Antifoam dosing equipment<br>Suction strainers- FRP |
| 07 | FW 226 | Emergency Quench water tank | Base Plate & its supports<br>Roof, Shell |
| 08 | FW 227 | Emergency Quench System | Emergency Quenching Spray Pipe<br>Nozzle for Emergency Pipe<br>Fasteners<br>Gaskets |
| 09 | FW 230 | Air oxidation System | Oxidation Blowers<br>Common Base Plate<br>Coupling and Guard<br>Anchor Bolts & Fasteners<br>Expansion Bellow<br>Suction & Discharge Silencers<br>Acoustic Enclosure<br>Water Injection cooling system |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) | |
| | | | | Pipe, Valves & Instruments<br>Special Tools | | | | |

| SNO | PGMA | PGMA DESCRIPTION | PGMA DETAILS |
|---|---|---|---|
| 10 | FW 244 | Oxidation air distribution System | Pipe & Fittings<br>Flanges<br>Pipe Hanger, Bottom Elbow, Bottom sliding supports |
| 11 | FW 251 | Expansion joint between bypass | Expansion joints<br>Seal Plates & Fasteners |
| 12 | FW 252 | Expansion joint between scrubbers | Fabric & its fixing fasteners<br>Sleeves & Flanges<br>Gaskets |
| 13 | FW 255 | Ducts between bypass duct inlet & booster fan | Plates & Stiffeners<br>Guide Vanes |
| 14 | FW 256 | Ducts between Booster fan & Absorber | Plates & Stiffeners<br>Guide Vanes |
| 15 | FW 257 | Ducts between Absorber & stack | Plates & Stiffeners<br>Guide Vanes |
| 16 | FW 260 | Duct structure between bypass duct& Booster fan | Duct Supports<br>Gusset Plate<br>Divider plate<br>Internal Struts<br>Support bearings |
| 17 | FW 261<br>FW 262 | Duct structure between booster fan& absorber & Absorber and Stack | Duct Supports<br>Gusset Plate<br>Divider plate<br>Internal Struts<br>Support bearings |
| 18 | FW 292 | Structures for Elevator | Columns<br>Seal Plate<br>Bracings<br>Enclosure (Purlin& sheeting) |
| 19 | FW 293 | Elevator and accessories | Base Frame<br>Buffer Spring<br>Mast Section<br>Cage<br>Control Panel & AC<br>Mandatory Spares |

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| SNO | PGMA | PGMA DESCRIPTION | PGMA DETAILS |
|---|---|---|---|
| 20 | FW 310 | Structures for booster fan handling | Columns<br>Beams<br>Bracings<br>Seal plate |
| 21 | FW 610<br>FW 722 | Galleries & railings for Scrubbers, Tank | Stairs<br>Handrail<br>Step treads<br>Floor grills<br>Ladders<br>Foundation bolts<br>Fasteners |
| 22 | FW 701 | Slurry pumps & accessories | Slurry Pumps incl Shaft seal<br>Common Base Plate<br>Coupling and Guard<br>Belt & Pulley<br>Expansion Bellow<br>Anchor Bolts & Fasteners<br>Motor & accessories<br>Sump Pumps incl Shaft seal<br>Common Base Plate<br>Coupling and Guard<br>Belt & Pulley<br>Anchor Bolts & Fasteners<br>Motor & accessories |
| 23 | FW 710 | Monorail for hoist& cranes | Insert Plate<br>Stiffener plate<br>Monorail beam |
| 24 | FW 721 | Agitator support | Channels & Beams |
| 25 | FW 730 | Limestone silo structures | Columns<br>Beams<br>Bracings<br>Seal plate<br>Angles, channels |

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER PAINT | PRIMER DFT (µm min.) | FINISH PAINT | FINISH DFT (µm min.) | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| SNO | PGMA | PGMA DESCRIPTION | PGMA DETAILS |
|---|---|---|---|
| 26 | FW 731 | Limestone silo | Base plate & its supports<br>Shell, Roof |
| 27 | FW 723<br>FW 724<br>FW 725 | Air cannon<br>Bag filter<br>Nozzles & flanges | Bag filter<br>Air cannon bin activator<br>Nozzles & Flanges |
| 28 | FW 733 | Limestone silo approach platforms | Stairs<br>Handrail<br>Step treads<br>Floor grills<br>Ladders<br>Foundation bolts<br>Fasteners |
| 29 | FW 734 | Limestone mill | Wet ball mill<br>Hydro cyclone- Mill area<br>Mill circuit pump<br>Mill separator tank with Agitator |
| 30 | FW 742 | Lime stone slurry storage tank | Base plate & its supports<br>Shell, Roof |
| 31 | FW 743 | Auxiliary Absorber tank | Base plate & its supports<br>Shell, Roof |
| 32 | FW 744 | Filtrate tank | Base plate & its supports<br>Shell, Roof |
| 33 | FW 745 | Wastage water tank | Base plate & its supports<br>Shell, Roof |
| 34 | FW 747 | Hydro cyclone waste water tank | Base plate & its supports<br>Shell, Roof |
| 35 | FW 748<br>FW 785<br>FW 786 | Process Water tank<br>Belt filter washing tank<br>Primary Hydro cyclone feed tank | Base plate & its supports<br>Shell, Roof |
| 36 | FW 751<br>FW 752 | Process water pipe accessories<br>Cooling water pipe accessories | CS/FRP Pipes & Fittings<br>Sight Glass<br>R Orifice<br>Gaskets & Fasteners |
| 37 | FW 753 | Slurry pipe accessories | CSRL/FRP Pipes & Fittings<br>Strainer (Cone)<br>Expansion Joint-Rubber<br>R Orifice<br>Gaskets & Fasteners |

| Sl No | SURFACE LOCATION | PGMA | SURFACE PREPARATION | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|---|
| | | | | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| SNO | PGMA | PGMA DESCRIPTION | PGMA DETAILS |
|---|---|---|---|
| 38 | FW 754 | Service air pipe accessories | GI Pipes & Fittings<br>Flexible Hose<br>Expansion Joint (Metallic)<br>Hose connector<br>R Orifice<br>Gaskets & Fasteners |
| 39 | FW 755 | Instrument air pipe accessories | SS Pipes & Fittings<br>Strainer(Y Type)<br>Gaskets & Fasteners |
| 40 | FW 815 to FW 851 | Valves and fittings | Globe valves<br>Ball Valves<br>Butterfly Valves<br>Diaphragm Valves<br>Gate Valves<br>CheckValves<br>Pinch Valves<br>Knife Gate Valves<br>Control Valves<br>Relief Valves |
| 41 | FW 761<br>FW 765 | Structures for Pipe racks<br>Structures for Sub pipe racks | Bracings<br>Columns |
| 42 | FW 280<br>FW 281<br>FW 282<br>FW 283<br>FW 740<br>FW 760<br>FW 763 | Foundation material for duct structure<br>Foundation material for absorber<br>Foundation material for Tanks<br>Foundation material for Pipe racks<br>Foundation material for Elevator<br>Foundation material for RC pump shed | Foundation bolts<br>Template |
| 43 | FW 766 | Platforms for Pipe rack | Stairs<br>Handrail<br>Step treads<br>Floor grills<br>Ladders<br>Foundation bolts<br>Fasteners |
| 44 | FW 768<br>FW 769 | Trestle for Main & sub Pipe racks | Truss<br>Beams, Supports for all Pipes |
| 45 | FW 779 | Supports for cable tray | Double Sup Channel & Base plates<br>Single Sup Channel & Base plates |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Sl No | SURFACE LOCATION | PGMA | PRIMER | | FINISH | | TOTAL DFT IN (µm min.) |
|---|---|---|---|---|---|---|---|
| | | | SURFACE PREPARATION | PAINT | DFT (µm min.) | PAINT | DFT (µm min.) |

| | | | |
|---|---|---|---|
| | | | Cantilever Arm<br>Fasteners & clamps<br>Brackets |
| 46 | FW 996 | Tools | Erection , commissioning, special tools |
| SNO | PGMA | PGMA DESCRIPTION | PGMA DETAILS |
| 47 | FW 798 | Air receivers | Instrument Air receivers<br>Any Instruments/Valves |
| 48 | FW 800 | Clarified water tank | Base plate & its supports<br>Shell, Roof |
| 49 | FW 802 | Neutralization tank & accessories | Base plate & its supports<br>Shell, Roof |
| 50 | FW 988<br>FW 997<br>FW 999 | Commissioning spares & Mandatory spares | Startup & commissioning spares<br>Mandatory spares |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**SECTION: I**

**SUB-SECTION: C-3**

**TECHNICAL SPECIFICATION (ELECTRICAL PORTION)**

619031/2021/PS-PEM-MAX



`

# TECHNICAL SPECIFICATION

# FOR

# GYPSUM DEWATERING SYSTEM (ELECTRICAL PORTION)

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

619031/2021/PS-PEM-MAX



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## 1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for GYPSUM DEWATERING SYSTEM **.**

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet minimum requirement of motor specification.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

## 2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

## 3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of

619031/2021/PS-PEM-MAX



compliance certificate/No deviation certificate.

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 :**

a) Electrical scope between BHEL & vendor

b) Customer (NTPC) specification for Motors

c) Customer ( NTPC) cabling spec ( to be referred by vendor for their scope of work (as per Electrical scope between BHEL & vendor)).

d) Quality plan for motors & NTPC quality assurance

e) Datasheet A for LT Motors (Annexure-I)

f) Datasheet C for LT & HT Motors (Annexure-X & Annexure-Y)

g) List of Mandatory Spares ( Annexure-II)

h) Sub vendor List for Motors & other Electrical items ( Annexure-III)

i) Electrical Load data format (Annexure –IV)

j) BHEL cable listing format (Annexure –V)

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

**PACKAGES: GYPSUM DEWATERING SYSTEM**
**SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT**
**PROJECT: 3X800 MW PATRATRU TPS**

| S.NO | DETAILS | SCOPE SUPPLY | SCOPE E&C | REMARKS |
|---|---|---|---|---|
| 1 | 11 kV / 3.3 KV / 415 V Switchgear | BHEL | BHEL | HT motor, (Motor feeder) power supply shall be provided by BHEL<br><br>For all LT motor & Auxiliary supply, 415 V AC (3 ph. 4 wire)/240 V AC (supply feeder) shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. |
| 2 | Local Push Button Station (for motors) | BHEL | BHEL | Located near the motor. |
| 3 | Power cables, control cables and screened control cables for<br>a) both end equipment in BHEL's scope<br>b) both end equipment in vendor's scope<br>c) one end equipment in vendor's scope | <br>BHEL<br>BHEL<br>BHEL | <br>BHEL<br>BHEL<br>BHEL | 1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly.<br>2. Termination at BHEL equipment terminals by BHEL.<br>3. Termination at Vendor equipment terminals by Vendor. |
| 4 | Junction box for control & instrumentation cable | Vendor | BHEL | Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling ( max 10-12 mtrs) and trunk cable. |
| 5 | Any special type of cable like compensating, co-axial, prefab, MICC etc. | Vendor | BHEL | |
| 6 | Cable trays, accessories & cable trays supporting system<br><br>100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling | BHEL<br><br>Vendor | BHEL<br><br>BHEL | Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage. |
| 7 | a. Cable glands<br>b. Lugs and bimetallic strip<br>for equipment supplied by Vendor | Vendor<br>Vendor | BHEL<br>BHEL | a. Double compression Ni-Cr plated brass cable glands<br>b. Solder less crimping type heavy duty tinned copper lugs for power and control cables. |
| 8 | Conduit and conduit accessories for cabling between | Vendor | BHEL | Conduits shall be medium duty, hot dip galvanised cold rolled mild steel |

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**

**PACKAGES: GYPSUM DEWATERING SYSTEM**
**SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT**
**PROJECT: 3X800 MW PATRATRU TPS**

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | | |
|---|---|---|---|---|
| | equipment supplied by vendor | | | rigid conduit as per IS: 9537. |
| 9 | Lighting | BHEL | BHEL | |
| 10 | Equipment grounding (including electronic earthing) & lightning protection | BHEL | BHEL | |
| 11 | Below grade grounding | BHEL | BHEL | |
| 12 | LT Motors with base plate and foundation hardware. | Vendor | BHEL | Makes shall be subject to customer/ BHEL approval at contract stage. |
| 13 | HT Motor with base plate and foundation hardware. | Vendor | BHEL | Makes shall be subject to customer/ BHEL approval at contract stage. |
| 14 | HT cable & Cable termination kit for HT Motor | BHEL | BHEL | |
| 15 | Mandatory spares | Vendor | - | Vendor to quote as per specification. |
| 16 | Recommended O & M spares | Vendor | - | As specified elsewhere in specification |
| 17 | Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system). | Vendor | BHEL | |
| 18 | a) Input cable schedules (Control & Screened Control Cables)<br>b) Cable interconnection details for above<br>c) Cable block diagram | Vendor<br>Vendor<br>Vendor | -<br>-<br>- | Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage. |
| 19 | Electrical Equipment & cable tray layout drawings | - | - | Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Gypsum Dewatering Building layout clearly indicating all motors, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc. |
| 20 | Electrical Equipment GA drawing | Vendor | - | For necessary interface review. |

NOTES:

1. Make of all electrical equipment/ items supplied shall be 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 without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB–SECTION – B-07

# MOTORS

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

## MOTORS

**1.00.00 GENERAL REQUIREMENTS**

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contractor shall provide fully compatible electrical system, equipment, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

| | | | |
|---|---|---|---|
| i) | Indoor motors | - | IP 54 |
| ii) | Outdoor motors | - | IP 55 |
| iii) | Cable box-indoor area | - | IP 54 |
| iv) | Cable box-Outdoor area | - | IP 55 |

**2.00.00 CODES AND STANDARDS**

| | | | |
|---|---|---|---|
| 1) | Three phase induction motors | : | IS/IEC:60034 |
| 2) | Single phase AC motors | : | IS/IEC:60034 |
| 3) | Crane duty motors | : | IS:3177, IS/IEC:60034 |
| 4) | DC motors/generators | : | IS/IEC:60034 |
| 5) | Energy Efficient motors | : | IS 12615, IEC: 60034-30 |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **3.00.00** | **TYPE** |
| 3.01.00 | **AC Motors:**<br>a) Squirrel cage induction motor suitable for direct-on-line starting.<br>b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30.<br>c) Crane duty motors shall be squirrel cage Induction motor as per the requirement.<br>d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable. |
| 3.02.00 | DC Motors Shunt wound |
| **4.00.00** | **RATING**<br>(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.<br>(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.<br>(c) For BFP motors, starting MVA shall be restricted to meet requirements indicated in B-0. |
| **5.00.00** | **TEMPERATURE RISE**<br>**Air cooled motors**<br>70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.<br>**Water cooled**<br>80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | 41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class 90 (Y) wet wound Boiler circulation pump motor. |
| **6.00.00** | **OPERATIONAL REQUIREMENTS** |
| 6.01.00 | **Starting Time** |
| 6.01.01 | For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time. |
| 6.01.02 | For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time. |
| 6.01.03 | For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time. |
| 6.01.04 | Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met. |
| 6.02.00 | **Torque Requirements** |
| 6.02.01 | Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. |
| 6.02.02 | Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors. |
| 6.03.00 | **Starting voltage requirement**<br>(a) Up to 85% of rated voltage for ratings below 110 KW<br>(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW<br>(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW<br>(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW<br>(e) Up to 75 % of rated voltage for ratings above 4000KW<br>Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **7.00.00** | **DESIGN AND CONSTRUCTIONAL FEATURES** |
| 7.01.00 | Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable. |
| 7.02.00 | All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below<br>(a) Fuel oil area : Group – IIB<br>(b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA / IEC60034) |
| 7.03.00 | Winding and Insulation<br>(a) Type : Non-hygroscopic, oil resistant, flame resistant<br>(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.<br>(c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & intertern insulation surge withstand level shall be as per IEC-60034 part-15.<br>However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better.<br>(d) 240VAC, 415V AC & 220V DC motors : Thermal Class ( B ) or better |
| 7.04.00 | Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 7.05.00 | Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature. |
| 7.06.00 | Noise level for all the motors shall be limited to 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads. |
| 7.07.00 | In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors. |
| 7.08.00 | Motor body shall have two earthing points on opposite sides. |
| 7.09.00 | 11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds. |
| 7.10.00 | 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) shall be provided. |
| 7.11.00 | The spacing between gland plate & center of terminal stud shall be as per Table-I. |
| 7.12.00 | All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment. |
| 7.13.00 | The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life. |
| 7.14.00 | For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box. |
| 7.15.00 | The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 8.00.00 | The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.<br>(a) 50 kW to 110 kW : 11.0<br>(b) From 110 KW & upto 200 KW : 9.0<br>(c) Above 200 KW & upto 1000KW : 10.0<br>(d) From 1001KW & upto 4000KW : 9.0<br>(e) Above 4000KW : 6 to 6.5 |
| 9.00.00 | CW motor shall be designed with minimum power factor of 0.8 at design duty point. |
| **10.00.00** | **TYPE TEST** |
| 10.01.00 | **HT MOTORS** |
| 10.01.01 | The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII-(BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer. |
| 10.01.02 | The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out. |
| 10.01.03 | In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor. |
| 10.01.04 | Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED "and carried out within last ten years from the date of bid opening. These reports should be for |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval. |
| 10.01.05 | **LIST OF TYPE TESTS TO BE CONDUCTED**<br><br>**The following type tests shall be conducted on each type and rating of HT motor**<br><br>(a) No load saturation and loss curves upto approximately 115% of rated voltage<br><br>(b) Measurement of noise at no load.<br><br>(c) Momentary excess torque test (subject to test bed constraint).<br><br>(d) Full load test (subject to test bed constraint)<br><br>(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose. |
| 10.01.06 | **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**<br><br>**The following type test reports shall be submitted for each type and rating of HT motor**<br><br>(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.<br><br>(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.<br><br>(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15<br><br>(d) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 10.02.00 | **LT Motors** |
| 10.02.01 | LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. |
| 10.02.02 | However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval. |
| 10.02.03 | **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**<br><br>**The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only**<br><br>1. Measurement of resistance of windings of stator and wound rotor.<br><br>2. No load test at rated voltage to determine input current power and speed<br><br>3. Open circuit voltage ratio of wound rotor motors ( in case of Slip ring motors)<br><br>4. Full load test to determine efficiency power factor and slip.<br><br>5. Temperature rise test.<br><br>6. Momentary excess torque test.<br><br>7. High voltage test.<br><br>8. Test for vibration severity of motor.<br><br>9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)<br><br>10. Test for degree of protection and<br><br>11. Over speed test. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1 |
| 10.03.00 | All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. |
| 10.04.00 | The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet. |

**TABLE - I**

**DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS**

| **Motor MCR in KW** | **Minimum distance between centre of stud and gland plate in mm** |
|---|---|
| **UP to 3 KW** | **As per manufacturer's practice.** |
| Above 3 KW - upto 7 KW | 85 |
| Above 7 KW - upto 13 KW | 115 |
| Above 13 KW - upto 24 KW | 167 |
| Above 24 KW - upto 37 KW | 196 |
| Above 37 KW - upto 55 KW | 249 |
| Above 55 KW - upto 90 KW | 277 |
| Above 90 KW - upto 125 KW | 331 |
| Above 125 KW-upto 200 KW | 203 |

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

**PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| Motor MCR in KW | Clearance |
|---|---|
| UP to 110 KW | 10mm |
| Above 110 KW and upto 150 KW | 12.5mm |
| Above 150 KW | 19mm |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB–SECTION – B-09

# CABLING

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**1.00.00 CODES AND STANDARDS**

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable .

| | |
|---|---|
| IS:513 | Cold rolled low carbon steel sheets and strips. |
| IS:802 | Code of practice for the use of Structural Steel in Overhead Transmission Line Towers. |
| IS:1079 | Hot Rolled carbon steel sheet & strips |
| IS:1239 | Mild steel tubes, tubulars and other wrought steel fIttings |
| IS:1255 | Code of practice for installation and maintenance of power cables upto and including 33 KV rating |
| IS:1367 Part-13 | Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners). |
| IS:2147 | Degree of protection provided by enclosures for low voltage switchgear and control gear |
| IS:2309 | Code of Practice for the protection of building and allied structures against lightning. |
| IS:2629 | Recommended practice for hot dip galvanising of iron & steel |
| IS:2633 | Method for testing uniformity of coating on zinc coated articles. |
| IS:3043 | Code of practice for Earthing |
| IS:3063 | Fasteners single coil rectangular section spring washers. |
| IS:6745 | Methods for determination of mass of zinc coating on zinc coated iron & steel articles. |
| IS:8308 | Compression type tubular in- line connectors for aluminium conductors of insulated cables |
| IS:8309 | Compression type tubular terminal ends for aluminium conductors of insulated cables. |
| IS:9537 | Conduits for electrical installation. |
| IS:9595 | Metal - arc welding of carbon and carbon manganese steels - recommendations. |
| IS:13573 | Joints and terminations for polymeric cables. |
| BS:476 | Fire tests on building materials and structures |
| IEEE:80 | IEEE guide for safety in AC substation grounding |
| IEEE:142 | Grounding of Industrial & commercial power systems |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| | DIN 46267 (Part-II) | Non tension proof compression joints for Aluminium conductors. |
| | DIN 46329 | Cable lugs for compression connections, ring type ,for Aluminium conductors |
| | BS:6121 | Specification for mechanical Cable glands for elastomers and plastic insulated cables. |
| | | Indian Electricity Act. |
| | | Indian Electricity Rules. |

1.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

**2.00.00 DESIGN AND CONSTRUCTIONAL FEATURE**

2.01.00 **Inter Plant Cabling**

2.01.01 Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly burried cables, if essential ,shall not have concentration of more than 4 cables in one route. All buried cables, Cables for switchyard and CHP shall be armoured

2.01.02 **Transformer yard**

In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.

2.01.03 **Trenches**

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

2.01.04 No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.

2.01.05 **Cable Vault**

Clear access passage of at least 750mm wide & 2.1 mt clear heights shall be provided at entrances and along the cable trays in cable vault. Wherever the passage is through cable routes & across the cable tray the clear height shall not be less than 1.5 mts.

Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.

Each cable vault should have at least two doors.

Exit signs shall be provided near doors for personnel escape in case of emergency

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 2.01.06 | **Boiler Area**<br><br>Two separate cable routes one on each side shall be provided for each boiler unit. Cables for on set of auxiliaries such as ID, FD, PA fan & half of the coal mills shall be routed in one route & for other set of auxiliaries through other route.<br><br>Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor.<br><br>Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area. |
| 2.01.07 | **Turbine Hall Area**<br>a)Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries. |
| 2.01.08 | **OffSite Area**<br><br>In offsite pumphouses, overhead cable tray arrangement shall be followed. However cable trenches may be considered below switchgear/mcc.<br>Trestle In fuel oil pump house, overhead cable tray arrangement shall be provided. RCC trenches provided in MCC room shall be separated from fuel oil area to avoid oil accumulation. |
| 2.01.09 | The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling. |
| 2.01.10 | Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable. |
| 2.01.11 | Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:<br><br>• Meet all safety requirements<br>• Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc |
| **3.00.00** | **EQUIPMENT DESCRIPTION** |
| 3.01.00 | **Cable trays, Fittings & Accessories** |
| 3.01.01 | Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables. |
| 3.01.02 | Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter. |
| 3.01.03 | Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm. |
| 3.01.04 | Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip |

galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm

3.02.00 **Support System for Cable Trays**

3.02.01 Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.

3.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.

e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:

The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079.

f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

g. Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Metre run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

3.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.

3.03.04 FOR COAL HANDLING PLANT THE FOLLOWING SHALL ALSO BE APPLICABLE**:**

a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.

b) Cable trenches shall be provided only in Switchgear/MCC rooms.

c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.

d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.

3.04.00 **Pipes, Fittings & Accessories**

3.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

3.03.02 GI Pipes shall be of medium duty as per IS: 1239

3.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

3.03.04 Hume pipes shall be NP3 type as per IS 458.

3.04.00 **Junction Boxes**

3.04.01 Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:-

(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102

(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.

(c) Class of protection shall be IP 55.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

(d) HV test.

3.04.02 Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.

3.05.00 **Terminations & Straight Through Joints**

3.05.01 Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter)..

3.05.02 Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design

3.05.03 1.1 KV grade Straight Through Joint shall be of proven design.

3.06.00 **Cable glands**

3.06.01 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

**3.07.00 Cable lugs/ferrules**

3.07.01 Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating

sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.

3.08.00 **Trefoil clamps**

3.08.01 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the peak value of maximum system short circuit current.

3.09.00 **Cable Clamps & Ties**

3.09.01 The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.

3.10.00 **Receptacles**

3.10.01 Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable adjustable mA sensitivity ranging from 30-300 mA

3.12.00 **Cable Drum Lifting Jack**

The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.

3.13.00 **Galvanising**

3.13.01 Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.

3.13.02 The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 3.14.00 | **Welding** |
| 3.14.01 | The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595 |
| **4.00.00** | **INSTALLATION** |
| 4.01.00 | **Cable tray and Support System Installation** |
| 4.01.01 | Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. |
| 4.01.02 | Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings. |
| 4.01.03 | The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated. |
| 4.01.04 | The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage. |
| 4.01.05 | All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor. |
| 4.01.06 | In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint. |
| 4.02.00 | **Conduits/Pipes/Ducts Installation** |
| 4.02.01 | The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor. |
| 4.02.02 | GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc. |
| 4.02.03 | Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

4.02.04 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

| **Conduit /pipe size (dia).** | **Spacing** |
|---|---|
| Upto 40 mm | 1 M |
| 50 mm | 2.0 M |
| 65-85 mm | 2.5 M |
| 100 mm and above | 3.0 M |

4.02.05 For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

4.03.00 **Junction Boxes Installation**

4.03.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

4.04.00 **Cable Installation**

4.04.01 Cable installation shall be carried out as per IS:1255 and other applicable standards.

4.04.02 For Cable unloading, pulling etc following guidelines shall be followed in general:

a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.

4.04.03 Cables shall be laid on cable trays strictly in line with cable schedule . Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| 4.04.04 | Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend.<br>Fibre Optical cable shall be laid in trenches/trays or as decided by Employer. |
| 4.04.05 | Bending radii for cables shall be as per manufacturer's recommendations and IS:1255. |
| 4.04.06 | Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe. |
| 4.04.07 | No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length. |
| 4.04.08 | In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing. |
| 4.04.09 | Wherever few cables are branching out from main trunk route troughs shall be used. |
| 4.04.10 | Wind loading shall be considered for designing support as well Cable trays wherever required. |
| 4.04.11 | Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures. |
| 4.04.12 | The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time. |
| 4.04.13 | **Separation**<br><br>At least 300mm clearance shall be provided between:<br><br>- HT power & LT power cables,<br><br>- LT power & LT control/instrumentation cables, |
| 4.04.14 | **Segregation**<br><br>1) Segregation means physical isolation to prevent fire jumping.<br><br>2) All cables associated with the unit shall be segregated from cables of other units.<br><br>3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or |

DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

4) In switchyard, control cables of each bay shall be laid on separate racks/trays.

4.04.15 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

| No. of cores in cable | No. of spare cores |
|---|---|
| 2C,3C | NIL |
| 5C | 1 |
| 7C-10C | 2 |
| 14C and above | 3 |

4.04.16 **Directly Buried Cables**

a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.04.17 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.

4.04.18 While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

4.05.00 **Cable Terminations & Connections**

4.05.01 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site. |
| 4.05.02 | Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager. |
| 4.05.03 | The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets. |
| 4.05.04 | Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position. |
| 4.05.05 | All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing. |
| 4.05.06 | All cable terminations shall be appropriately tightened to ensure secure and reliable connections. |
| **5.00.00** | |
| 5.01.00 | |
| 5.02.00 | |
| 5.03.00 | |
| 5.04.00 | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | | |
|---|---|---|---|---|
| बीएचईएल BHEL | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | SPEC. NO : | DATE:27.02.2020 |
| | | CUSTOMER : | QP NO.: PED-506-00-Q-007, REV-04 | |
| | | PROJECT: | PO NO.: | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM: | SECTION: II | SHEET 1 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 1.0 | RAW MATERIAL & BOUGHT OUT CONTROL | | | | | | | | | | | | | |
| 1.1 | SHEET STEEL, PLATES, SECTION, EYEBOLTS | 1.SURFACE CONDITION | MA | VISUAL | 100% | - | - | FREE FROM BLINKS, CRACKS, WAVINESS ETC | LOG BOOK | | P | - | - | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | -DO- | | P | - | - | |
| | | 3.PROOF LOAD TEST (EYE BOLT) | MA | MECH. TEST | -DO- | - | -DO- | -DO- | TEST REPORT | | P/V | - | | |
| 1.2 | HARDWARES | 1.SURFACE CONDITION | MA | VISUAL | 100% | - | | FREE FROM CRACKS, UN-EVENNESS ETC. | -DO- | | P | - | - | |
| | | 2.PROPERTY CLASS | MA | VISUAL | SAMPLES | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | SUPPLIERS TC & LOG | | P/V | - | - | PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR |
| 1.3 | CASTING | 1.SURFACE CONDITION | MA | VISUAL | 100% | - | | FREE FROM CRACKS, BLOW HOLES ETC. | LOG BOOK | | P/V | - | | |
| | | 2.CHEM. & PHY. PROP. | MA | CHEM & MECH TEST | 1/HEAT NO. | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | SUPPLIER'S TC | | P/V | - | | HEAT NO. SHALL BE VERIFIED |
| | | 3.DIMENSIONS | MA | MEASUREMENT | 100% | - | MANUFACTURER'S DRG. | MANUFACTURER'S DRG. | LOG BOOK | | P/V | - | | |
| 1.4 | PAINT & VARNISH | 1.MAKE, SHADE, SHELF LIFE & TYPE | MA | VISUAL | 100% CONTINUOUS | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | LOG BOOK | | P/V | - | | |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 27/3/2020 | Hema K. | Checked by: | 27/3/20 | MONAC GANDHI |
| Reviewed by: | 2/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev. 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE:27.02.2020 |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 2 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 1.5 | SHAFT (FORGED OR ROLLED) | 1. SURFACE COND. | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | -DO- | | P | - | - | VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED |
| | | 2. CHEM. & PHYSICAL PROPERTIES | MA | CHEM. & PHYSICAL TESTS | 1/HEAT NO. OR HEAT TREATMENT BATCH NO | - | MANUFACTURER'S DRG./ SPEC. | MANUFACTURER'S DRG./ STD. | SUPPLIER'S TC | | P/V | - | | |
| | | 3. DIMENSIONS | MA | MEASUREMENT | 100% | - | -DO- | MANUFACTURER'S DRG. | LOG BOOK | | P/V | - | | |
| | | 4.INTERNAL FLAWS | CR | ULTRASONIC TEST | 100% | 100% | ASTM-A388 | MANUFACTURER'S STD. | -DO- | ✓ | P/W | V | - | FOR DIA OF 55 MM & ABOVE |
| 1.6 | SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S | 1. MAKE & RATING | MA | VISUAL | -DO- | - | MANUFACTURER'S DRG./STD. | MANUFACTURER'S DRG./STD. | -DO- | | P/V | - | - | |
| | | 2. PHYSICAL COND. | MA | -DO- | -DO- | - | - | NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY | -DO- | | P/V | - | - | |
| | | 3.DIMENSIONS (WHEREVER APPLICABLE) | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG./ STD | MANUFACTURER'S DRG. / STD. | -DO- | | P/V | - | - | |
| | | 4.PERFORMANCE/ CALIBRATION | MA | TEST | 100% | - | -DO- | -DO- | TEST REPORT | | P/V | - | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 27/3/2020 | Hema K. | Checked by: | 27/3/20 | RONAL GANDHI | | |
| Reviewed by: | 27/3/2020 | P. Dutta | Reviewed by: | | | | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | DATE:27.02.2020 |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 3 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 1.7 | OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC. | 1. SURFACE COND. ETC. | MA | VISUAL | 100% | - | - | NO VISUAL DEFECTS | TEST REPORT | | P/V | - | - | |
| | | 2. OTHER CHARACTERISTICS | MA | TEST | SAMPLE | - | MANUFACTURER'S STD. | MANUFACTURER'S STD. | LOG BOOK AND OR SUPPLIER'S TC | | P/V | - | - | |
| 1.8 | SHEET STAMPING (PUNCHED) | 1. SURFACE COND. | MA | VISUAL | 100% | - | - | NO VISUAL DEFECTS (FREE FROM BURS) | LOG BOOK | | P | - | - | |
| | | 2.DIMENSIONS INCLUDING BURS HEIGHT | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG. | MANUFACTURER'S DRG. | -DO- | | P/V | - | - | |
| | | 3. ACCEPTANCE TESTS | MA | ELECT. & MECH TESTS | -DO- | - | MANUFACTURER'S DRG./ STD. | MANUFACTURER'S DRG./ STD. | SUPPLIER'S TC | | P/V | - | - | |
| 1.9 | CONDUCTORS | 1. SURFACE FINISH | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | LOG BOOK | | *P/V | - | - | * MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER. |
| | | 2.ELECT. PROP. & MECH. PROP | MA | ELECT. & MECH.TEST | SAMPLES | - | MANUFACTURER'S DRG./ SPEC. | MANUFACTURER'S / SPEC. | SUPPLIERS TC & VENDOR'S TEST REPORTS | | P/V | - | - | |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 27/2/2020 | Hema K. | Checked by: | 27/2/20 | KUNAL GANDHI |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX

619031/2021/PS-PEM-MAX
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | DATE:27.02.2020 |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 4 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| | | 3.DIMENSIONS | MA | MEASUREMENT | -DO- | - | -DO- | -DO- | Log Book | | P/V | - | - | |
| 1.10 | BEARINGS | 1.MAKE & TYPE | MA | VISUAL | 100% | - | MANUFACTURER'S DRG./ APPROVED DATASHEET | MANUFACTURER'S DRG./ APPROVED DATASHEET | -DO- | | P/V | - | - | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | APPROVED DATASHEET | APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES | -DO- | | P/V | - | - | |
| | | 3.SURFACE FINISH | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | -DO- | | P/V | - | - | |
| 1.11 | SLIP RING (WHEREVER APPLICABLE) | 1.SURFACE COND. | MA | VISUAL | 100% | - | - | -DO- | -DO- | | P | - | - | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | -DO- | | P | - | - | |
| | | 3.TEMP.WITH-STAND CAPACITY | MA | ELECT.TEST | -DO- | - | MANUFACTURER'S STD./ APPROVED DATASHEET | MANUFACTURER'S STD./ APPROVED DATASHEET | -DO- | | P/V | - | - | |
| | | 4.HV/IR | MA | -DO- | 100% | - | -DO- | -DO- | -DO- | | P/V | - | - | |
| 1.12 | OIL SEALS & GASKETS | 1.MATERIAL OF GASKET | MA | VISUAL | 100% | - | MANUFACTURER'S DRG/SPECS | MANUFACTURER'S DRG./ SPECS. | -DO- | | P | - | - | |
| | | 2.SURFACE COND. | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | -DO- | | P | - | - | |
| | | 3.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | -DO- | | P | - | - | |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 27/2/2020 | Hema K. | Checked by: | | KUNAL GHOSH |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | DATE:27.02.2020 |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 5 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 2.0 | IN PROCESS | | | | | | | | | | | | | |
| 2.1 | STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR ) | 1.WORKMANSHIP & CLEANNESS | MA | VISUAL | 100% | - | -DO- | GOOD FINISH | LOG BOOK | | P/W | - | - | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | -DO- | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | -DO- | | P | - | - | |
| 2.2 | MACHINING | 1.FINISH | MA | VISUAL | 100% | - | -DO- | GOOD FINISH | LOG BOOK | | P | - | - | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | -DO- | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | -DO- | | P | - | - | |
| | | 3.SHAFT SURFACE FLOWS | MA | PT | 100% | 100% | MANUFACTURER'S STD./ ASTM-E165 | MANUFACTURER'S STD./ APPROVED DATASHEET. | -DO- | ✓ | P | V | - | |
| 2.3 | PAINTING | 1.SURFACE PREPARATION | MA | VISUAL | 100% | - | MANUFACTURER'S STD./APPROVED DATASHEET | SAME AS COL.7 | LOG BOOK | | P | - | - | |
| | | 2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT) | MA | MEASUREMENT BY ELCOMETER | SAMPLE | - | -DO- | -DO- | -DO- | | P | - | - | |
| | | 3.SHADE | MA | VISUAL | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| | | 4.ADHESION | MA | CROSS CUTTING & TAPE TEST | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 27/3/2020 | Hema K. | Checked by: | 28/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | | | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | DATE:27.02.2020 |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 6 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 2.4 | SHEET STACKING | 1.COMPLETENESS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S STD. | MANUFACTURER'S STD. | LOG BOOK | | P | - | - | |
| | | 2.COMPRESSION & TIGHTENING | MA | MEASUREMENT | 100% | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| 2.5 | WINDING | 1.COMPLETENESS | CR | VISUAL | 100% | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | P | - | - | |
| | | 2.CLEANLINESS | CR | -DO- | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| | | 3.IR-HV-IR | CR | ELECT. TEST | 100% | 100% | IS-325/IS-12615/IEC-60034 PART-1 | IS-325/IS-12615/IEC-60034 PART-1 | LOG BOOK | ✓ | P | V | - | |
| | | 4.RESISTANCE | CR | -DO- | 100% | 100% | IS-325/IS-12615/IEC-60034 PART-1 | IS-325/IS-12615/IEC-60034 PART-1 | LOG BOOK | ✓ | P | V | - | |
| | | 5.INTERTURN INSULATION | CR | -DO- | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| 2.6 | IMPREGNATION | 1.VISCOSCITY | MA | PHY. TEST | AT STARTING | - | MANUFACTURER'S STANDARD | MANUFR'S STANDARD | LOG BOOK | | P | - | - | |
| | | 2.TEMP. PRESSURE VACCUM | MA | PROCESS CHECK | CONTINUOUS | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | | P | - | - | |
| | | 3.NO. OF DIPS | MA | -DO- | CONTINUOUS | CONTINUOUS | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | ✓ | P | V | - | THREE DIPS TO BE GIVEN |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 2/3/2020 | Hema K. | Checked by: | 2/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 02/3/2020 | P.Dutta | Reviewed by: | | | | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX

197

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

619031/2021/PS-PEM-MAX

| | | | | |
|---|---|---|---|---|
| बी एच ई एल BHEL | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | SPEC. NO : | DATE:27.02.2020 |
| | | CUSTOMER : | QP NO.: PED-506-00-Q-007, REV-04 | |
| | | PROJECT: | PO NO.: | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM: | SECTION: II | SHEET 7 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | - | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| | | 4.DURATION | MA | -DO- | CONTINUOUS | CONTINUOUS | -DO- | -DO- | LOG BOOK | ✓ | P | V | - | |
| 2.7 | COMPLETE STATOR ASSEMBLY | 1.COMPACTNESS & CLEANLINESS | MA | VISUAL | 100% | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| 2.8 | BRAZING/COMPRESSION JOINT | 1.COMPLETENESS | CR | -DO- | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| | | 2.SOUNDNESS | CR | MALLET TEST & UT | 100% | 100% | -DO- | -DO- | LOG BOOK | ✓ | P | V | - | |
| | | 3.HV | MA | ELECT. TEST | 100% | 100% | -DO- | -DO- | LOG BOOK | ✓ | P | V | - | |
| 2.9 | COMPLETE ROTOR ASSEMBLY | 1.RESIDUAL UNBALANCE | CR | DYN. BALANCE | -DO- | - | MANUFACTURER'S SPEC./ ISO 1940 | MANUFACTURER'S DWG. | LOG BOOK | | P | - | - | |
| | | 2.SOUNDNESS OF DIE CASTING | CR | ELECT. (GROWLER TEST) | 100% | 100% | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | ✓ | P | V | - | |
| 2.10 | ASSEMBLY | 1.ALIGNMENT | MA | MEAS. | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| | | 2.WORKMANSHIP | MA | VISUAL | -DO- | - | -DO- | -DO- | LOG BOOK | | P | - | - | |
| | | 3.AXIAL PLAY | MA | MEAS. | 100% | 100% | -DO- | -DO- | LOG BOOK | ✓ | P | V | - | |
| | | 4.DIMENSIONS | MA | -DO- | -DO- | - | MANUFACTURER'S DRG./ MANUFACTURER'S SPEC. | MANUFACTURER'S DRG/ RELEVANT IS | LOG BOOK | | P | - | - | |
| | | 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE | MA | VISUAL | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | | P | - | - | |
| | | 6. RTD, BTD & SPACE HEATER MOUNTING. | MA | VISUAL | 100% | 100% | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | ✓ | P | V | - | |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 27/2/2020 | Hema K. | Checked by: | 27/2/20 | KUNAL GANDHI |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | DATE:27.02.2020 |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 8 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 3.0 | TESTS | 1.TYPE TESTS INCLUDING SPECIAL TESTS | MA | ELECT.TEST | 1/TYPE/SIZE | 1/TYPE/SIZE | IS-325//IS-12615/APPROVED DATASHEET | IS-325/IS-12615/APPROVED DATASHEET | TEST REPORT | | P | W* | W* | * NOTE - 1 |
| | | 2.ROUTINE TESTS INCLUDING SPECIAL TEST | MA | -DO- | 100% | 100% | -DO- | -DO- | -DO- | | P | V /W$ | V /W$ | $ NOTE - 2 |
| | | 3.VIBRATION & NOISE LEVEL | MA | -DO- | 100% | 100% | IS: 12075 / IEC 60034-14 & IS-12065 | IS: 12075 / IEC 60034-14 & IS-12065 | -DO- | | P | V /W$ | V /W$ | $ NOTE - 2 |
| | | 4.OVERALL DIMENSIONS AND ORIENTATION | MA | MEASUREMENT & VISUAL | 100% | 100% | APPROVED DRG/DATA SHEET | APPROVED DRG/DATA SHEET & | TEST/INSPC. REPORT | | P | W | - | |
| | | 5.DEGREE OF PROTECTION | MA | ELECT. & MECH. TEST | 1/TYPE/ SIZE | 1/TYPE/ SIZE | IEC 60034-5/IS-12615 | APPROVED DATASHEET | TC | ✓ | P | V | V | TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3 |
| | | 6. MEASUREMENT OF RESISTANCE OF RTD & BTD | MA | -DO- | 100% | 100% | IS-325//IS-12615/IEC-60034 PART-1/IS: 12802 | IS-325/IS-12615/IEC-60034 PART-1/IS: 12802 | -DO- | | P | V /W$ | V /W$ | $ NOTE - 2 |
| | | 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER | MA | -DO- | 100% | 100% | IS-325//IS-12615/IEC-60034 PART-1 | IS-325/IS-12615/IEC-60034 PART-1 | -DO- | | P | V /W$ | V /W$ | $ NOTE - 2 |
| | | 8. NAME PLATE DETAILS | MA | VISUAL | 100% | 100% | IS-325//IS-12615& DATA SHEET | IS-325//IS-12615 & DATA SHEET | TEST/INSPC. REPORT | | P | V /W$ | V /W$ | $ NOTE - 2 |
| | | 9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED) | MA | EXPLOSION FLAME PROOF TEST | 1/TYPE | 1/TYPE | IS 2148 / IEC 60079-1 | IS 2148 / IEC 60079-1 | TC | ✓ | P | V | V | TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3 |
| | | 10. PAINT SHADE, THICKNESS & FINISH | MA | VISUAL & MEASUREMENT BY ELKOMETER | SAMPLE | SAMPLE | APPROVED DATASHEET | APPROVED DATASHEET | TC | | P | W$ | W$ | SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY<br>$ NOTE - 2 |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 31/2/2020 | Heera R. | Checked by: | 27/2/20 | KUNAL GANDHI |
| Reviewed by: | 03/2/2020 | P. Dutt | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE:27.02.2020 |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-007, REV-04 | |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 9 OF 9 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 4.0 | PACKING | SURFACE FINISH & COMPLETENESS | MA | VISUAL | 100% | 100% | AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING. | AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING. | INSPC. REPORT | | P | W | - | IF APPLICABLE, REFER SEAWORTHY PACKING ALSO. |

**NOTES:**

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

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.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

**LEGENDS:**

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER,

P: PERFORM. W: WITNESS. V: VERIFICATION. AS APPROPRIATE

MA: MAJOR, MI: MINOR, CR: CRITICAL

D: DOCUMENT

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 2/3/2020 | Hema K. | Checked by: | 2/3/20 | KUNAL GANDHI |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX

| | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN . | | SPEC. NO : | DATE:27.02.2020 |
|---|---|---|---|---|---|
| | | CUSTOMER : | | QP NO.: PED-506-00-Q-006, REV-02 | |
| | | PROJECT: | | PO NO.: | |
| | | ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V)) | SYSTEM: | SECTION: II | SHEET 1 OF 2 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 1.0 | ASSEMBLY | 1.WORKMANSHIP | MA | VISUAL | 100% | - | MFG. SPEC. | MFG. SPEC. | -DO- | | P | - | - | |
| | | 2.DIMENSIONS | MA | -DO- | -DO- | - | MFG. DRG./ MFG. SPEC. | MFG. DRG./ MFG. SPEC. | -DO- | | P | - | - | |
| | | 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE | MA | VISUAL | 100% | - | MFG.SPEC./ | MFG.SPEC. | -DO- | | P | - | - | |
| 2.0 | PAINTING | 1.SHADE | MA | VISUAL | SAMPLE | - | MFG. SPEC/ APPROVED DATASHEET | SAME AS COL.7 | LOG BOOK | | P | - | - | |
| 3.0 | TESTS | 1.ROUTINE TEST INCLUDING SPECIAL TEST | MA | -DO- | 100% | 100% | IS-325 / IS-12615/ APPROVED DATA SHEET | SAME AS COL.7 | TEST/ INSPN. REPORT | | P | W | W | NOTE -1 & NOTE-2 |
| | | 2.OVERALL DIMENSIONS & ORIENTATION | MA | MEASUREMENT & VISUAL | 100% | 100% | APPROVED DRG/DATA SHEET | APPROVED DRG/DATA SHEET | TEST/ INSPN. REPORT | | P | W | W | NOTE -1 & NOTE-2 |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 27/3/2020 | Hema K. | Checked by: | Kunal Gandhi 27/3/20 | KUNAL GANDHI |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PED-506-00-Q-006, REV-02 | DATE:27.02.2020 |
| | PROJECT: | | PO NO.: | |
| | ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V)) | SYSTEM: | SECTION: II | SHEET 2 OF 2 |

| Sl No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| | | 3.NAMEPLATE DETAILS | MA | VISUAL | 100% | 100% | IS-325 / IS-12615 / APPROVED DATA SHEET | SAME AS COL.7 | TEST/ INSPN. REPORT | | P | W | W | |
| 4.0 | PACKING | SURFACE FINISH & COMPLETENESS | MA | VISUAL | 100% | 100% | AS PER MFG. STANDARD / APPROVED PACKING DRAWING.(#) | AS PER MFG. STANDARD / APPROVED PACKING DRAWING.(#). | INSPC. REPORT | | P | W | - | (#) APPLICABLE FOR EXPORT JOBS |

**NOTES:**

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

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.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

**LEGENDS:**

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M:** SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B:** MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C:** CUSTOMER,
**P:** PERFORM, **W:** WITNESS, **V:** VERIFICATION, AS APPROPRIATE
**MA:** MAJOR, **MI:** MINOR, **CR:** CRITICAL
**D:** DOCUMENT

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | 27/3/2020 | Hema K. | Checked by: | 27/3/20 | KUNAL GANDHI |
| Reviewed by: | 02/3/2020 | P. Dutta | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

619031/2021/PS-PEM-MAX
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# MOTOR

| TESTS/CHECKS / TEMS/COMPONENTS | Visual | Dimensional | Make/Type/Rating /General Physical Inspection | Mech/Chem. Properties | NDT /DP/MPI/UT | Metallography | Electrical Characteristics | Welding/Brazing(WPS/PQR) | Heat Treatment |
|---|---|---|---|---|---|---|---|---|---|
| Plates for stator frame, end shield, spider etc. | Y | Y | Y | Y | Y | | | | Y |
| Shaft | Y | Y | Y | Y | Y | Y | | | Y |
| Magnetic Material | Y | Y | Y | Y | | | Y | | |
| Rotor Copper/Aluminium | Y | Y | Y | Y | | | Y | | Y |
| Stator copper | Y | Y | Y | Y | | | Y | | Y |
| SC Ring | Y | Y | Y | Y | Y | | Y | Y | Y |
| Insulating Material | Y | | Y | Y | | | Y | | |
| Tubes, for Cooler | Y | Y | Y | Y | Y | | | | Y |
| Sleeve Bearing | Y | Y | Y | Y | Y | | | | Y |
| Stator/Rotor, Exciter Coils | Y | Y | Y | | | | Y | Y | |
| Castings, stator frame, terminal box and bearing housing etc. | Y | Y | Y | Y | Y | | | Y | |
| Fabrication & machining of stator, rotor, terminal box | Y | Y | | | Y | | | Y | Y |
| Wound stator | Y | Y | | | | | Y | Y | |
| Wound Exciter | Y | Y | | | | | Y | Y | |
| Rotor complete | Y | Y | | | | | Y | | |
| Exciter, Stator, Rotor, Terminal Box assembly | Y | Y | | | | | Y | | |
| Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc. | Y | Y | Y | | | | | | |
| Complete Motor | Y | Y | Y | | | | | | |

**Note**:
1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW.
2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.

Y1 = for HT Motor / Machines only.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## MOTOR

| TESTS/CHECKS / ITEMS/ COMPONENTS | Magnetic Characteristics | Hydraulic/Leak/Pressure Test | Thermal Characteristics | Run out | Dynamic Balancing | Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I | Vibration | Over speed | Tan delta, shaft voltage & polarization index test | Paint shade, thickness & adhesion |
|---|---|---|---|---|---|---|---|---|---|---|
| Plates for stator frame, end shield, spider etc. | | | | | | | | | | |
| Shaft | | | | | | | | | | |
| Magnetic Material | Y | | Y | | | | | | | |
| Rotor Copper/Aluminium | | | | | | | | | | |
| Stator copper | | | Y | | | | | | | |
| SC Ring | | | | | | | | | | |
| Insulating Material | | | Y | | | | | | | |
| Tubes for Cooler | | Y | | | | | | | | |
| Sleeve Bearing | | Y | | | | | | | | |
| Stator/Rotor, Exciter Coils | | | | | | | | | | |
| Castings, stator frame, terminal box and bearing housing etc. | | | | | | | | | | |
| Fabrication & machining of stator, rotor, terminal box | | | | | | | | | | |
| Wound stator | | | | | | | | | | |
| Wound Exciter | | | | | | | | | | |
| Rotor complete | | | | Y | Y | | | | | |
| Exciter, Stator, Rotor, Terminal Box assembly | | | | | | | | | | |
| Accessories, RTD, BTD,CT, , Space heater, antifriction bearing, gaskets etc. | | | | | | | | | | |
| Complete Motor | | | | | | Y | Y | Y | Y1 | Y |

**Note**: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW.

2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard

3. Makes of major bought out items for HT motors will be subject to NTPC approval.

Y1 = for HT Motor / Machines only.

| | | |
|---|---|---|
| | **LV MOTORS**<br><br>**DATA SHEET-A** | SPECIFICATION NO.<br>VOLUME II B<br>SECTION D<br>REV NO. 00 DATE 30.05.2018<br>SHEET 1 OF 1 |

| | | | |
|---|---|---|---|
| 1.0 | Design ambient temperature | : | 50 °C |
| 2.0 | Maximum acceptable kW rating of LV motor | : | ≤200KW |
| 3.0 | Installation (Indoors/ Outdoors) | : | As required |
| 4.0 | Degree Of Protection (Indoor/Outdoor) | : | IP54/IP55 |
| 5.0 | Type of Cooling | : | TEFC/CACA/TETV |
| 6.0 | Details of supply system | | |
| | a) Rated voltage (with variation) | : | 415V ± 10% |
| | b) Rated frequency (with variation) | : | 50 Hz (Variation: +3% TO –5%) |
| | c) Combined voltage & freq. variation | : | 10% |
| | d) System fault level at rated voltage | : | 50 kA for 1 sec |
| | e) Short time rating for terminal boxes | | |
| | ○ 110kW & Above (Breaker controlled) | : | 50 kA for 1 sec |
| | ○ Below 110kW (SFU+ Contactor controlled) | : | 50 KA for 0.20 sec. |
| | f) LV System grounding | : | Solidly |
| 7.0 | Class of insulation | : | Refer clause 7.03.00 of Customer Motor Specification |
| 8.0 | Minimum voltage for starting (As percentage of rated voltage) | : | Refer clause 6.03.00 of Customer Motor Specification |
| 9.0 | Power cables data | : | Shall be given during Detailed engg. |
| 10.0 | Earth Conductor Size & Material | : | Shall be given during Detailed engg. |
| 11.0 | Space heater supply | : | 240 V, 1Φ , 50 Hz |
| 12.0 | Rating up to which Single phase motor | : | Acceptable upto 0.20 kW |
| 13.0 | Tests | : | As per Customer motor spec. (enclosed) |
| 14.0 | Energy efficient/ Flame proof motor | : | As per Customer spec. requirement |

- **Also detail Customer spec. for Motors to be referred as enclosed with the specification.**

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | LIST OF MANDATORY SPARES | |
|---|---|---|
| 2.03.00 | **ELECTRICAL ACTUATORS** | |
| | 1 Actuators | 10% (or) 1 no. of each type, model and rating, whichever is more. |

**Note :**

One (1) set means total numbers as required for one complete replacement for one equipment.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

Vendor to refer to this list for items in their scope only( as indicated in Electrical scope sheet between BHEL & Vendor)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| एनटीपीसी NTPC | PROJECT :PATRATU STPS ( 3X800 MW)<br>PACAKGE : EPC<br>Sub Package: MOTORS & VVF Drive Panels<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | | | | | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ;<br>CONTRACTOR-M/S BHEL | | | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br>DATE 20th April 2017 | |
| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9585-001-QVE- | QP SUB. SCH. | QP APPL SCHE DULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL. STATUS AS PER NTPC | SC APPL SCHE DULE | REMARKS |
| 1) | L T (415 V) Motors | Refer Note 1 | | | | ABB | FARIDABAD | A | | UPTO 55KW |
| | | | | | | ABB | BANGALORE | A | | 55KW – 200KW |
| | | | | | | BHARAT BIJLEE | MUMBAI | A | | RQP, FOR FLAME PROOF ALSO |
| | | | | | | CGL | AHMEDNAGAR | A | | FOR FLAME PROOF ALSO |
| | | | | | | JYOTI | BARODA | A | | |
| | | | | | | KEC | BANGALORE | A | | FOR FLAMEVPROOF ALSO |
| | | | | | | KEC | HUBLI | A | | UPTO 90KW: FOR FLAME PROOF ALSO |
| | | | | | | LHP | SOLAPUR | A | | UPTO 200KW |
| | | | | | | MARATHON | KOLKATA | A | | FOR FLAME PROOF ALSO |
| | | | | | | NGEF | BANGALORE | A | | UPTO 15KW |
| | | | | | | SIEMENS | MUMBAI | A | | |
| 2) | HT MOTOR | 1 | | | | BHEL | BHOPAL | A | | |



169

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



| एनटीपीसी NTPC | PROJECT :PATRATU STPS ( 3X800 MW)<br>PACAKGE : EPC<br>Sub Package: MOTORS & VVF Drive Panels<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | | | | | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ;<br>CONTRACTOR-M/S BHEL | | | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 20th April 2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9585-001-QVE- | QP SUB. SCH. | QP APPL SCHE DULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL. STATUS AS PER NTPC | SC APPL SCHE DULE | REMARKS |

NOTE 1 : FOR LT MOTORS

a) Less than 30 KW

Acceptance of Motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing /data sheets.

b) 30 KW -50KW

Acceptance of Motor rating between 30 KW & 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along with COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing /data sheets.

c) Above 50 KW as per NTPC approved quality plan

Approval Conditions attached to above vendors-as applicable shall prevail.

General Notes:

1) Vendor list & category of the mandatory spares shall be as mentioned above.
2) For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
3) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

NTPC

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi ★

(JATIN GAHLAWAT)
BHEL

Patratu Vidyut Utpadan Nigam Limited ★ C&M Deptt. ★ Distt-Ramgarh (Jharkhand)

Vendor to refer to this list for items in their scope only( as indicated in Electrical scope sheet between BHEL & Vendor)

| | | | |
|---|---|---|---|
| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SC APPL SCHEDULE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 10. | GI cable trays, fitting | I | | | | Inar Profiles Ltd | Enkapalli | A | | |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi ★

Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) ★ C & M Deptt.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

Appendix B, Page 193 of 278

| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |
|---|---|---|---|

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SCAPPL SCHEDULE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | & accessories including bends | | | | | Vatco | Mumbai | A | | Galvanization at Sigma Mumbai |
| | | | | | | Indiana cable trays | Mumbai | A | | Galvanization at Karamtara galvaniser |
| | | | | | | Industrial Perforation | Kolkata | A | | |
| | | | | | | Ratan Engineering | Kolkata | A | | Galvanization at B.P. Projects |
| | | | | | | India Electric Syndicate | Kolkata | A | | Galvanization at BMW Industries/B.P Projects |
| | | | | | | Steelite engg. | Mumbai | A | | |
| | | | | | | Premier Power Products | Kolkata | A | | Galvanising at Neha Galvaniser |
| | | | | | | Indiana Gratings | Pune | A | | Galvanization at Poona Galvanizer/ Anand Yeknow Aids Engg |
| | | | | | | M.J. Engineering | Okhla/ Bhiwadi | A | | |
| | | | | | | Jamna Metal | Delhi/ Kundli | A | | |
| | | | | | | T.R.G | Chennai | A | | Galvanization at TM Radhakrishna Chetty & Co |
| | | | | | | Amtech | Pune | A | | Galvanization at B.G. Shirke - Pune |
| | | | | | | Kannade Anand Udyog | Mumbai | A | | Fabrication at their units: Plot No. 42, Moriv District Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane. |
| | | | | | | Rukmani | Raipur | A | | Ladder type cable trays only |
| | | | | | | Passive Infra | Hasangarh (Rohtak) | A | | |
| | | | | | | Unitech Fabricators & | Howrah/ | A | | |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Ltd. ★ C & M Deptt. ★ Distt-Ramgarh(Jharkhand)



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |
|---|---|---|---|

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SC AP PL SC HE DU LE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Engineers | Hoogly (Kolkata) | | | |
| | | | | | | Patny System | Hyderabad | A | | Galvanisation at Gurpreet galvaniser - Hyderabad |
| | | | | | | Rabi Engg | Kolkata | A | | Galvanizing from NTPC approved sources |
| | | | | | | Advance Power Products | Howrah | A | | |
| | | | | | | Maheswari Electricals | Noida | DR | | |
| | | | | | | Saral Industries | Raibareli | DR | | |
| | | | | | | Parmar Metal | Rajkot | DR | | |
| | | | | | | Pentax | Mumbai | DR | | |
| | | | | | | Eros metal | Nagpur | DR | | |
| | | | | | | Vinfab | Thane | DR | | |
| | | | | | | Namdhari | Ludhiana | DR | | |
| | | | | | | Indmark Formtech | PUNE | DR | | |
| 11. | Cable tray flexible support system (GI) | I | 9 | | | Vatco | Mumbai | A | | Galvanising at Sigma Mumbai |
| | | | | | | Inar profiles | Enkapalli | A | | |
| | | | | | | Industrial perforations | Kolkata | A | | |
| | | | | | | Premier power products | Kolkata | A | | Galvanising at Neha Galvaniser |
| | | | | | | Steelite engg. | Mumbai | A | | |
| | | | | | | Indiana gratings | Pune | A | | Galvanising at Poona Galvaniser |
| | | | | | | Amtech | Pune | A | | Galvanising at B.G. Shirke |
| | | | | | | Ratan Projects | Kolkata | A | | Galvanization at NTPC approved sources |
| | | | | | | Indmark Formtech | PUNE | DR | | |
| 12. | Lead coated steel flexible conduits | III | | | | M/s PLICA | Ghaziabad | A | | |
| | | | | | | M/s Lapp | Germany | DR | | |
| | | | | | | M/s Bansal Labs | Bhopal | A | | |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi ★

Patratu Vidyut Utpadan Nigam Limited ★ C & M Deptt. ★ Distt-Ramgarh(Jharkhand)



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SCAPPL SCHEDULE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 13. | Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized) | III | | | | Main contractor approved sources with galvanization from NTPC approved sources (Note-2) | | Noted | | |
| 14. | FRP Junction boxes | II | 10 | | | Main Contractor approved sources | | Noted | | |
| 16. | Cable glands | III | | | | Main contractor approved sources | | Noted | | |
| 17. | Cable lugs | III | | | | M/s Dowell | Mumbai | A | | |
| | | | | | | M/s Billets Elektro Werke Ltd. | Umbergaon | A | | |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi ★

★ Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) ★ C & M Deptt.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | | | | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | | | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 | | |
| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SCAPPL SCHEDULE | REMARKS |
| | | | | | | (3 D) | | | | |
| | | | | | | M/s Chetna | Nasik | A | | |
| | | | | | | Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no. Refer Note-3 | | Noted | | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



Deptt. Disit-Ramgarh(Jharkhand)

| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |
|---|---|---|---|

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SCAPPL SCHEDULE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 26. | PVC conduit/hume pipe/lighting wire/GI pipes/HDPE pipe/Structural Steel | III | | | | BIS licensee / ISI marked with valid CML number | | A | | |
| 27. | GI steel rigid conduit/ epoxy conduit | III | | | | BIS licensee with valid CML number | | A | | |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi ★

Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) ★ C & M Deptt.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |
|---|---|---|---|

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SC APPL SCHEDULE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|

NB:
Under Sub Supplier approval status as per NTPC column:
A: mean that vendor for this item is acceptable to NTPC.
Under QP / INSPN CATEGORY column:

CAT-I : For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection & witness by NTPC

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of verification of documents as per approved QP
CAT-III : For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.
**@ : Vendors acceptance is subject to sub-QR clearance.**
**Note-1- Approval conditions attached to above identified vendors, as applicable shall be adhered to.**
Note-2 – List of NTPC acceptable galvanizers

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

★ Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) C & M Deptt.



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| एनटीपीसी NTPC | PROJECT :Patratu STPP (2X660 MW)<br>PACAKGE :EPC<br>Sub Package: Electrical Equipment Supply & Erection<br>CONTRACTOR : M/S BHEL<br>CONT. NO. CS-9585-001-2 | LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR<br>Contractor-M/S BHEL | REF NO : 9585-001-QOE-R-01<br>REVISION NO. 00<br><br>DATE 24th April 2017 |

| Sl. No. | ITEM | QP / INS CAT. | QP No:- 9578-001-QVE- | QP SUB. SCH. | QP APPL SCHEDULE | SUB-SUPPLIERS | PLACE | SUB-SUPPLIER APPL STATUS AS PER NTPC | SCAPPL SCHEDULE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| 1. M/s M J Engg,Delhi<br>2. M/s Jamna Metal,Delhi<br>3. M/s A.V. Engg, Kolkata<br>4. M/s Inar Profiles, Vishakapatnam<br>5. M/s Anand Udyog, Mumbai<br>6. M/s Techno Engg,Chandigarh<br>7. M/S Steelite Engg, Mumbai | 8. M/s National Galvanizer, Kolkata<br>9. M/s Unistar Galvanizer, Kolkata<br>10. M/s B.P. Project. Kolkata<br>11. M/s Bajaj Pune<br>12. M/s Electrocare Industries, Mumbai<br>13. M/s B.G. Shirke, Pune<br>14. M/s Gurpreet Galvanizer, Hyderabad<br>15. M/s Sigma, Mumbai | 16. M/s Radhakrishnan Shetty, Chennai<br>17. Karamtara Mumbai<br>18.Poona Galvanizers Pune<br>19. Neha Galvanizer- Kolkata<br>20. Unitech galvanizers- Hoogly<br>21. Gurpreet galvanizers- Hyderabad<br>22- DMP Projects- Kolkata | *Additional galvanizer/s , if any , proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.* |

Note-3 : VDE / CE / UL / CSA MARKING FOR PRODUCT QUALITY: SELF CERTIFICATION/VALID CERTIFICATION FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER WITH CML NO. FOR PRODUCT QUALITY SHALL BE SUBMITTED FOR NTPC's INFORMATION

NTPC

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) ★ C & M Deptt.

Jatin
(JATIN GAHLAWAT)
BHEL



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

202

| LOAD TITLE | RATING (KW / A) | | UNIT (U)/STN (S) | Nos. | | VOLTAGE CODE* | FEEDER CODE** | EMER. LOAD (Y) | CONT.(C)/ INTT.(I) | STARTING TIME >5 SEC (Y) | LOCATION | BOARD NO. | CABLE | | BLOCK CABLE DRG. No. | CONTROL CODE | REMARKS | LOAD No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NAME PLATE | MAX. CONT. DEMAND (MCR) | | RUNNING | STANDBY | | | | | | | | SIZE CODE | NOs | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

ANNEXURE-IV

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

| | | | | | | |
|---|---|---|---|---|---|---|
| LOAD DATA (ELECTRICAL) | JOB NO. | 434 | ORIGINATING AGENCY | | PEM (ELECTRICAL) | |
| | PROJECT TITLE | 3x800MW PATRATU STPP | NAME | | DATA FILLED UP ON | |
| | SYSTEM | FUEL OIL SYSTEM | SIGN. | | DATA ENTERED ON | |
| | DEPTT. / SECTION | MAUX | SHEET 1 OF 1 | REV. 00 | DE'S SIGN. & DATE | |

**CABLE LISTTING FORMAT**

| CABLE ID | FROM | TO | PURPOSE | CABLE SCOPE ( BHEL PEM/VENDOR) | REMARKS | CABLE SIZE | PATH CABLE NO |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| CLAUSE NO. | Bidder's Name …….. | एनटीपीसी NTPC |
|---|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# PART-II

# TECHNICAL INFORMATION AND DATA TO BE SUBMITTED AFTER AWARD OF CONTRACT

| | | |
|---|---|---|
| **DE-1A** | **HT MOTORS** | |
| **A.** | **GENERAL** | |
| 5. | Manufacturer & Country of origin.(Shall be as per approved QA make) | |
| 6. | Equipment driven by motor | |
| 7. | Motor type | |
| 8. | Quantity | |
| **B.** | **DESIGN AND PERFORMANCE DATA** | |
| 17. | Frame size | |
| 18. | Type of duty | |
| 19. | Type of enclosure /Method of cooling/ Degree of | |
| 20. | Applicable standards to which motor generally | |
| 21. | (a)Whether motor is flame proof | Yes/No |
| | (b)If yes, the gas group to which it conforms as per IS:2148 | |
| 22. | Type of mounting | |
| 23. | Direction of rotation as viewed from DE END | |
| 24. | Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW) | |
| 25. | Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW) | |
| 26. | Maximum continuous load demand at design duty point of driven equipment in KW | |
| 27. | Rated Voltage (volts) | |
| 28. | Permissible variation of : | |
| d. | Voltage (Volts) | |
| e. | Frequency (Hz) | |

| CLAUSE NO. | Bidder's Name …….. |
|---|---|

| | | |
|---|---|---|
| f. | Combined voltage and frequency | |
| 29. | Rated speed at rated voltage and frequency | |
| 30. | At rated Voltage and frequency: | |
| c. | Full load current | |
| d. | No load current | |
| 31. | Power Factor at | |
| d. | 100% load | |
| e. | NO load | |
| f. | Starting. | |
| 32. | Efficiency at rated voltage and frequency | |
| d. | 100% load | |
| e. | 75% load | |
| f. | 50% load | |
| 33. | Starting current (amps) at | |
| a. | 100 % voltage | |
| b. | 85% voltage | |
| c. | 80% voltage | |
| 34. | Minimum permissible starting Voltage (Volts) | |
| 35. | Starting time with minimum permissible voltage | |
| a. | Without driven equipment coupled | |
| b. | With driven equipment coupled | |
| 36. | Safe stall time with 100% and 110% of rated voltage | |
| a. | From hot condition | |
| b. | From cold condition | |
| 37. | Torques : | |
| a. | Starting torque at min. permissible voltage(kg-mtr.) | |
| b. | Pull up torque at rated voltage. | |
| c. | Pull out torque | |
| d. | Min accelerating torque (kg.m) available | |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. | |
|---|---|---|
| e. | Rated torque (kg.m) | |
| 38. | Stator winding resistance per phase (ohms at 20 Deg.C.) | |
| 39. | $GD^2$ value of motors | |
| 40. | No of permissible successive starts when motor is in | |
| 41. | Locked Rotor KVA Input | |
| 42. | Locked Rotor KVA/KW | |
| 43. | Vibration limit | |
| a. | Velocity (mm/s) | |
| b. | Displacement (microns) | |
| 44. | Noise level limit (dBA) | |
| **C.** | **CONSTRUCTIONAL FEATURES** | |
| 1. | Stator winding insulation | |
| | a. Class & Type | |
| | b. Winding Insulation Process shall be VPI | Yes/No |
| | c. Tropicalised (Yes/No) | |
| | d. Temperature rise over specified max. | |
| | i. Cold water temperature of 38 DEG. C. | |
| | ii. Ambient Air 50 DEG. C. | |
| | e. Method of temperature measurement | |
| | f. Stator winding connection | |
| | g. Number of terminals brought out | |
| 2. | Type of terminal box for following: | |
| | a. Stator leads | |
| | b. Space heater | |
| | c. Temperature detectors(RTDs,BTDs) | |
| | d. Instrument switch etc. | |
| 3. | Bearing | |
| | a. Type DE/NDE | |
| | b. Manufacturer | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. |
|---|---|

| | | |
|---|---|---|
| | c. Self Lubricated or forced Lubricated | |
| | d. Recommended lubricant | |
| | e. Oil quantity | |
| | f. Max cold oil temp. to bearing | |
| | g. Guaranteed life in Hrs | |
| | h. Lubrication type | |
| 4. | Oil pressure gauge/ switch | |
| | a. Range | |
| | b. Contact Nos. & ratings | |
| | c. Accuracy | |
| 5. | Type of cooler (CACA/CACW)/ Number | |
| 6. | Cooling water requirements | |
| | a. Quantity required | |
| | b. Maximum permissible inlet water temp. in deg.C | |
| | c. Pressure of water at inlet to coolers | |
| | d. Outlet temperature of water at full load | |
| | e. Cold air temp. at outlet | |
| 7. | Paint shade | |
| 8. | Max. permissible temperature of rotor (deg.C) | |
| 9. | Temp. Rise of rotor during 1st start (deg.C) | |
| 10. | Temp. rise of rotor during 2nd start (deg.C) | |
| 11. | Surge withstand voltage (stator winding) as per IEC- | |
| | a. Lightning impulse withstand level (1.2/50 micro sec surge)(KVp) | |
| | b. Interturn insulation surge withstand level (KVp) | |
| 12. | Weight of | |
| | a. Motor stator (KG) | |
| | b. Motor Rotor (KG) | |
| | c. Total weight (KG) | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. |
|---|---|

| | | |
|---|---|---|
| | | |
| **D.** | **List of accessories.** | |
| 1. | RTDs for winding(Type/Nos/Leads/Location/make/Res.at 0 Deg.C) | |
| 2. | RTDs for bearing(Type/Nos/Leads location/make/Res.at 0 Deg.C) | |
| 3. | RTDs for Hot Air (Type/No/Leads) | |
| 4. | RTDs for Cold Air (Type/No./Leads) | |
| 5. | Space Heaters | |
| | i) Nos. | |
| | ii) Total Power (Watts) | |
| | iii) Supply Voltage | |
| 6. | Stator Terminal Box | |
| | i) Type | |
| | ii) Fault Level (MVA)/Fault Level duration (secs) | |
| | iii) Location(viewed from NDE side) | |
| | iv) Entry of cables (bottom/side) | |
| | v) Recommended cable size(To be matched with cable size envisaged by owner) | |
| 7. | Cable glands & lugs details (shall be suitable for power cable) | |
| 8. | Neutral Terminal box Type | |
| 9. | Current Transformer | |
| | i) Nos. | |
| | ii) Ratio | |
| | iii) Accuracy Class | |
| | iv) Knee Point Voltage-Vk (Volts) | |
| | v)Exciting Current | |
| | vi) Max Secondary Resistance | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. |
|---|---|

| | | |
|---|---|---|
| 10. | Dial Type Thermometer | |
| | i) For Bearings (Nos.) | |
| | ii) For Air Temp (Nos.) | |
| | a. Hot Air | |
| | b. Cold Air | |
| | iii) Contact Rating | |
| | iv) Range | |
| | v) Supply Votlage | |
| 11. | Rotor Terminal Box | |
| 12. | TBs for RTDs. BTDs & Space Heater (Yes/No) | |
| 13. | Sole Plate (Yes/No) | |
| 14. | Foundation & Anchoring bolts (Yes/No) | |
| 15. | Base Frame (Yes/No) | |
| 16. | Speed switch (Yes/No) | |
| | i) No of contacts and contact ratings of speed | |
| 17. | Insulation of bearing (Yes/No) | |
| 18. | Forced oil lubrication (Yes/No) | |
| 19. | Oil level indicator (Yes/No) | |
| 20. | Noise reducer(Yes/No) | |
| 21. | Flow switch for CACW motor (Quantity) | |
| | i) No of contacts and contact ratings | |
| 22. | Water leakage detector | |
| | i) No of contacts and contact ratings | |
| 23. | Grounding pads | |
| | i) No and size on motor body | |
| | ii) Nos on terminal Box | |
| 24. | Vibration pads | |
| | i) Nos and size | |
| | ii) Location | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. |
|---|---|

| | | |
|---|---|---|
| 25. | Any other fitments | |
| **E.** | **List of curves.** | |
| 1. | Torque speed characteristic of the motor | |
| 2. | Calibration characteristic of platinum type resistance temperature detector | |
| 3. | Calibration characteristic of platinum BTD | |
| 4. | Thermal withstand characteristic | |
| 5. | Starting. current Vs. Time | |
| 6. | Starting. current Vs speed | |
| 7. | Neg. sequence current vs Time.. | |
| 8. | P.F. and Effi. Vs Load | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. |
|---|---|

| DE-1B | LT MOTORS | |
|---|---|---|
| A. | GENERAL | |
| 5. | Manufacturer & Country of origin. (Shall be as per approved QA make) | |
| 6. | Equipment driven by motor | |
| 7. | Motor type | |
| 8. | Quantity | |
| B. | DESIGN AND PERFORMANCE DATA | |
| 18. | Frame size | |
| 19. | Type of duty | |
| 20. | Type of enclosure /Method of cooling/ Degree of | |
| 21. | Applicable standard to which motor generally | |
| 22. | Efficiency class as per IS 12615 | |
| 23. | (a)Whether motor is flame proof | Yes/No |
| | (b)If yes, the gas group to which it conforms as per IS:2148 | |
| 24. | Type of mounting | |
| 25. | Direction of rotation as viewed from DE END | |
| 26. | Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW) | |
| 27. | Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW) | |
| 28. | Maximum continuous load demand of driven | |
| 29. | Rated Voltage (volts) | |
| 30. | Permissible variation of : | |
| | a. Voltage (Volts) | |
| | b. Frequency (Hz) | |
| | c. Combined voltage and frequency | |
| 31. | Rated speed at rated voltage and | |
| 32. | At rated Voltage and frequency: | |
| | a. Full load current | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. | |
|---|---|---|
| | b. No load current | |
| 33. | Power Factor at | |
| | a. 100% load | |
| | b. NO load | |
| | c. Starting. | |
| 34. | Efficiency at rated voltage and frequrecy, | |
| | a.100% load | |
| | b. 75% load | |
| | c. 50% load | |
| 35. | Starting current (amps) at | |
| | a. 100 % voltage | |
| | b. 85% voltage | |
| | c. 80% voltage | |
| 36. | Minimum permissible starting Voltage (Volts) | |
| 37. | Starting time with minimum permissible voltage | |
| | a. Without driven equipment coupled | |
| | b. With driven equipment coupled | |
| 38. | Safe stall time with 100% and 110% of rated | |
| | a. From hot condition | |
| | b. From cold condition | |
| 39. | Torques : | |
| | a. Starting torque at min. permissible voltage(kg- | |
| | b. Pull up torque at rated voltage. | |
| | c. Pull out torque | |
| | d. Min accelerating torque (kg.m) available | |
| | e.Rated torque (kg.m) | |
| 40. | Stator winding resistance per phase (ohms at 20 | |
| 41. | $GD^2$ value of motors | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. | |
|---|---|---|
| 42. | No of permissible successive starts when motor is in hot condition | |
| 43. | Locked Rotor KVA Input | |
| 44. | Locked Rotor KVA/KW | |
| 45. | Vibration limit :Velocity (mm/s) | |
| 46. | Noise level limit (dBA) | |
| **C.** | **CONSTRUCTIONAL FEATURES** | |
| 1. | Stator winding insulation | |
| | a. Class & Type | |
| | b. Winding Insulation Process | |
| | c. Tropicalised (Yes/No) | |
| | d. Temperature rise over specified maximum ambient temperature of 50 deg C | |
| | e. Method of temperature measurement | |
| | f. Stator winding connection | |
| 2. | Main Terminal Box | |
| | a. Type | |
| | b. Location(viewed from NDE side) | |
| | c. Entry of cables(bottom/side) | |
| | d. Recommended cable size(To be matched with cable size envisaged by owner) | |
| | e. Fault level (MVA),Fault level duration(sec) | |
| | f. Cable glands & lugs details (shall be suitable for | |
| 3. | Type of DE/NDE Bearing | |
| 4. | Motor Paint shade | |
| 5. | Weight of | |
| | a. Motor stator (KG) | |
| | b. Motor Rotor (KG) | |
| | c. Total weight (KG) | |
| **D.** | **List of accessories.** | |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. | |
|---|---|---|
| 1. | 3. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage) | |
| 2. | Terminal Box for Space Heater (Yes/No) | |
| 3. | Speed switch (Yes/No) | |
| 4. | Insulation of bearing (Yes/No) | |
| 5. | Noise reducer(Yes/No) | |
| 6. | Grounding pads | |
| | i) No and size on motor body | |
| | ii) Nos on terminal Box | |
| 7. | Vibration pads | |
| | i) Nos and size | |
| | ii) Location | |
| 8. | Any other fitments | |
| **E.** | **List of curves.** | |
| 1. | Torque speed characteristic of the motor | |
| 2. | Thermal withstand characteristic | |
| 3. | Starting. current Vs. Time | |
| 4. | Starting. current Vs speed | |
| 5. | P.F. and Effi. Vs Load | |
| **F.** | **Additional Data to be filled for each rating of DC Motor** | |
| 1. | Rated armature voltage (Volt) | |
| 2. | Rated field excitation (Amp) | |
| 3. | Permissible % variation in voltage | |
| 4. | Minimum Permissible Starting voltage (volt) | |
| 5. | At rated voltage | |
| | i)Full load Armature current.(Amp) | |
| | ii)Full load Field current (Amp) | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | Bidder's Name …….. | |
|---|---|---|

| | | |
|---|---|---|
| | iii)No load Armature current (Amp) | |
| 6. | Full load Field current (Amp) | |
| 7. | No load Aramature current (Amp) | |
| 8. | Minimum permissible field current(Amp) to avoid | |
| | i) Maximum permissible voltage | |
| | ii) Rated voltage | |
| | iii) Minimum Permissible Voltage | |
| 9. | Resistance (indicative Values) in ohm | |
| | i)Armature winding(Arm + IP + Series) at 25 | |
| | ii) Field Winding at 25 deg. C | |
| 10.. | Inductance (indicative values) | |
| | i) Armature winding | |
| | ii) Field winding | |
| 11 | Value of trimmer resistance (ohm) to be connected in series with the shunt field to | |
| | i) 220 V DC | |
| | ii) 250 V DC | |
| | iii) 187 V DC | |
| 12 | Value of the external resistance (ohm)required to be connected in series with armature during starting only | |
| 13 | Technical data sheet for external resistance box | |
| 14 | GA drawing of motor | |
| 15 | Starting time calculation | |
| 16 | Starter resistance design calculation | |
| 17 | Electrical connection diagram of motor | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**SECTION: I**

**SUB-SECTION: C-4**

**TECHNICAL SPECIFICATION (C&I PORTION)**

| | | |
|---|---|---|
| | **3 x 800 MW PVUNL PATRATU TPP PHASE-I**<br>**SPECIFICATION No: PE-TS-434-571-A001** | SECTION: C4 |
| | **TECHNICAL REQUIREMENTS (C&I)**<br>**GYPSUM DEWATERING SYSTEM** | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# CONTROL AND INSTRUMENTATION FOR GYPSUM DEWATERING SYSTEM

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# C&I SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

# INDEX



| S. No. | DESCRIPTION |
|---|---|
| 1 | TITLE SHEET |
| 2 | INDEX SHEET |
| 3 | C&I SPECIFIC TECHNICAL REQUIREMENTS |
| 4 | GENERAL TECHNICAL SPECIFICATION |
| 5 | LIST OF DOCUMENTS/DELIVERABLES |
| 6 | MEASURING INSTRUMENTS (PRIMARY & SECONDARY) |
| 7 | DATA SHEETS FOR MOTORISED VALVE ACTUATOR |
| 8 | SIGNL EXCHANGE BETWEEN DRIVES & DCS |
| 9 | DRIVE AND INSTRUMENT INTERFACE DIAGRAM |
| 10 | INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY |
| 11 | QUALITY ASSURANCE |
| 12 | TYPE TEST REQUIREMENT |
| 13 | INSTRUMENT STUB DETAILS |
| 14 | INSTRUMENT INSTALLATION DRAWING |
| 15 | SUB VENDOR LIST |
| 16 | FORMAT FOR PROVENNESS CERTIFICATE |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# C&I SPECIFIC TECHNICAL REQUIREMENT
# FOR DCS BASED
# GYPSUM DEWATERING SYSTEM

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## Specific Technical Requirements (C&I):

1. GYPSUM DEWATERING SYSTEM (GDS) shall be operated from DCS (BHEL's scope).

2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire GDS except marked as BHEL's scope in P&ID attached in specification. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will 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.

3. The make/model of various instruments/items/systems shall be as per NTPC approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

4. All instruments and control elements shall be terminated on JB/LCP in field. JB/LCP is in bidder's scope for bidder's supplied instrument and in BHEL's scope for BHEL's supplied instrument. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.

5. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

6. Bidder to provide mandatory spares as per mandatory spares list.

7. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference.

8. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.

9. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.

10. The quantity of instruments for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

11. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.

12. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.

13. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

14. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.

15. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter, JB/Rack & other erection hardware.

16. Bidder to provide temperature sensor along with temperature transmitter for HT drives i.e. Pump and Motor for BRG and winding temp measurement.

17. Vibration Monitoring System, is envisaged for HT Motor, which is in BHEL scope. However, for mounting of vibration sensors/probe, vendor to provide vibration pad (of dimension of 80mm x 80mm x 10mm each) for mounting of sensors and a notch/slot for mounting of key phasor.

18. Bidder to provide Flow measuring device suitable for the service condition, which shall be decided by BHEL/customer during detail engineering. Bidder to comply the requirement without any commercial implication.

19. Bidder to furnish electrical load/UPS load data during detailed engineering. UPS Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.

20. Interface of MCC, HT SWGR, Solenoid valves, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.

21. Local control panel if any required for operation shall be in bidder scope.

22. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

23. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

24. Diaphragm seal shall be provided with Instruments having contact with corrosive media.

25. Redundancy of sensors shall be provided by bidder

    (i) Triple redundancy for all Analog and binary inputs required for protection of system/drives.
    (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.

26. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm2.

27. Use of process actuated shall be avoided unless unavoidable.

28. Number of pairs to be selected for Screen /Control cable
    a) F-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
    b) G-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
    c) Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm2

29. Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."
30. In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.
31. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.
32. Measuring instruments (primary & secondary), analysers offered for this package shall have at least one year's satisfactory operation in one power station having unit rating of 200 MW or above. Provenness certificate shall be provided as per the attached format (Annexure - 1).

33. All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.

34. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# GENERAL TECHNICAL SPECIFICATION CONTROL & INSTRUMENTATION

FORM NO. PEM-6666-0

| | | |
|---|---|---|
| BHEL | **SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES** | SPECIFICATION NO.: |
| | | VOLUME |
| | | SUB SECTION |
| | | REV. NO. / DATE : |
| | | SHEET / OF |

**GENERAL REQUIREMENT**

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# LIST OF DOCUMENTS/DELIVERABLES

| LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT | | | |
|---|---|---|---|
| **Sl. No.** | **DRAWING NO.** | **DRAWING/DOCUMENT TITLE** | **CATEGORY** |
| | | | |
| 1 | PE-V4-434-145-I901 | CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS | A |
| 2 | PE-V4-434-145-I902 | CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS) | A |
| 3 | PE-V4-434-145-I903 | HMI PICTURES/PLANT SCHEMATICS | A |
| 4 | PE-V4-434-145-I904 | INSTRUMENT SCHEDULE WITH SET POINTS | A |
| 5 | PE-V4-434-145-I905 | I/O LIST (ANALOG & BINARY) | A |
| 6 | PE-V4-434-145-I906 | DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA | A |
| 7 | PE-V4-434-145-I907 | FIELD JB/LIE/LIR,DRIVES TERMINATIONS | A |
| 8 | PE-V4-434-145-I908 | DATASHEETS FOR INSTRUMENTS, JBs, etc. | A |
| 9 | PE-V4-434-145-I909 | QUALITY PLANS (INSTRUMENTS, VMS, etc.) | A |
| 10 | PE-V4-434-145-I910 | INSTRUMENT HOOK-UP DRAWING | A |
| 11 | PE-V4-434-145-I911 | THERMOWELL SIZING CALCULATION | A |
| 12 | PE-V4-434-145-I913 | CABLE SCHEDULE & INTERCONNECTION | A |
| 13 | PE-V4-434-145-I914 | ANNUNCIATION & SOE LIST | A |

NOTES:
ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL, MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc.
SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# MEASURING INSTRUMENTS (PRIMARY & SECONDARY) & SPECIFICATION FOR ELECTRONIC TRANSMITTERRS

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 1.00.00 | **MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)** |
| 1.01.00 | Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval. |
| 1.02.00 | Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus. |
| 1.03.00 | All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering. |
| 1.04.00 | The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm. |
| 1.05.00 | All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).<br>For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications.<br>For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum. |
| 1.06.00 | For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**2.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

**2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS**

| Sl.No. | Features | Essential/Minimum Requirements |
|---|---|---|
| 1. | Type of Transmitter | Microprocessor based 2 wire type (loop powered), Hart protocol compatible. |
| 2. | Accuracy | ± 0.1% of calibrated span (minimum) |
| 3. | Output signal range | 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol) |
| 4. | Turn down ratio (minimum) | 10:1 for vacuum/very low pressure applications (i.e. pressure <= 200 mmWC)<br>5:1 for very high pressure application (i.e. pressure >= 200 Kg/cm2)<br>30:1 for other applications |
| 5. | Stability | ± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm²<br>± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² |
| 6. | Zero and span drift | +/- 0.015% per deg.C at max span<br>+/-0.11% per deg.C at min. Span |
| 7. | Load impedance | 500 ohm (minimum) |
| 8. | Housing | Weather proof as per IP-65, metallic housing with durable corrosion resistant coating |
| 9. | Over Pressure | 150% of max. Operating pressure |
| 10. | Connection (Electrical) | Plug and socket type |
| 11. | Process connection | 1/2 inch NPT (F) |
| 12. | Span and Zero | Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility. |
| 13. | Accessories | -Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.<br>-2 valve manifold for absolute & Gauge pressure transmitters, 3-valve and 5 valve manifold for DP/Level/Flow applications. The valve manifold shall be non integral type (except Fuel Oil area). |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| | | -For hazardous area, explosions proof enclosure as described in NEC article 500<br>Mounting: 2 inch pipe mounting. |
| 14. | Diagnostics & display | Self-Indicating feature and digital display on transmitter |
| 15. | Power supply | 24V DC ± 10%. |
| 16. | Adjustment/calibration/maintenance | From hand held HART calibrator/ centralized PC based system (as applicable). |

Notes

- For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

**2.02.00 GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER**

| | |
|---|---|
| Type | Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter. |
| Principle | TDR (Time domain reflectometry) |
| Probe Type & Material | (i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention.<br>(ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable. |
| Output signal | 4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention. |
| Accuracy | +/- 0.5% of calibrated span or minimum 5mm. |
| Power supply | 24 VDC +/- 10%. |
| Housing | Weather proof as per IP-65, metallic housing with durable corrosion resistance coating. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| Adjustment/ calibration | Using hand held HART calibrator/ centralized PC based system (as applicable). |
| Zero & span adjustment | Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc. |
| Display | Integral digital display. |
| Load Impedance | 500 ohms (minimum). |
| Electromagnetic compatibility | Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2 |
| Mounting | (i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor.<br><br>(ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor.<br><br>(iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. |

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

**2.03.00 Ultrasonic Type level Transmitter**

| S.No. | Features | Essential/Minimum requirement |
|---|---|---|
| 1. | Type of Transmitter | Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter. |
| 2. | Output signal | 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol). |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| 3. | Accuracy | +/- 0.5% of calibrated span or minimum 5mm. |
| 4. | Power supply | 24 V DC +/- 10%. |
| 5. | Temperature compensation | To be provided within transducer. |
| 6. | Housing | Weather proof as per IP-65, metallic housing with durable corrosion resistance coating. |
| 7. | Adjustment/calibration/ maintenance | Using hand held HART calibrator/ centralized PC based system (as applicable). . |
| 8. | Zero and Span adjustment | Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc. |
| 9. | Sensor Material | Corrosion resistant material to suit individual application requirement. |
| 10. | False signal tolerance | Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry. |
| 11. | Range | Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc. |
| 12. | Display | Integral digital display |
| 13. | Diagnostics | Loss of echo alarm etc. |
| 14. | Load Impedance | 500 ohms (minimum). |
| 15. | Electrical Connection | Plug and socket |

| | | |
|---|---|---|
| 16. | Accessories | • All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.<br>• All mounting accessories required for erection and commissioning shall be provided.<br>• For hazardous area, explosion proof enclosure as described in NEC article 500 |

**Note:**

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under "ultrasonic transmitters" category for fly ash silo level.

2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.

2.04.00 HART Hand Held calibrator

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**3.00.00** **Temperature Elements and accessories**

**3.01.00** **Thermocouple**

| Sr. No. | Features | | Essential/Minimum Requirements |
|---|---|---|---|
| 1 | Type of Thermocouple. | : | 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type). |
| 2 | No. of element | : | Duplex |
| 3 | Housing/Head | : | IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well. |
| 4 | Insulation and Sheathing of Thermocouple | : | Swaged type mineral (magnesium oxide) insulation and SS316 sheath. |
| 5 | Calibration and accuracy | : | As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C. |
| 6 | Accessories | : | Thermo well and associated fittings |
| 7 | Standard | : | IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well |

**3.02.00** **Resistance Temperature Detector ( RTD )**

| Sr. No. | Features | | Essential/Minimum Requirements |
|---|---|---|---|
| 1 | Type of RTD. | : | Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade). |
| 2 | No. of element | : | Duplex |
| 3 | Housing/Head | : | IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| | | | provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well |
| 4 | Insulation and sheathing of RTD | : | Mineral (magnesium oxide) insulation and SS316 sheath, |
| 5 | Calibration and accuracy | : | As per As per IEC-751/ DIN-43760 Class-A for RTD |
| 6 | Accessories | : | Thermo well and associated fittings |
| 7 | Standard | : | IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well. |

**NOTES :**

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**3.04.00** **Thermo well** (for all process temp. elements)

(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

**3.05.00** **Not Used**

**3.06.0** **TEMPERATURE TRANSMITTER (TT)**

Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter With **integral** Indicator:

These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum.

d. Common requirements for each of the above type of temperature transmitters.

| | | |
|---|---|---|
| Output | : | 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. |
| Input | : | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K & R types (input type to be selectable at site through HART terminal). |
| Isolation | : | Min. 500 V AC. |
| EMC compatibility | : | As per EN 61326. |
| Operating ambient temperature | : | 0 to 85 deg C (without indicator).<br>0 to 70 deg C (with indicator). |
| Power supply | | 24V DC +/- 10%. |
| Accessories | | Mounting arrangements including clamps etc. |
| Composite Accuracy (Refer note 2 ) | (i) | For head mounted and DIN-rail mounted types:<br>RTD =<0.4% of 0-250 deg C span<br>T/C-K type =<0.4% of 0-600 deg C span<br>T/C-R type =<0.4% of 0-1000 deg C span<br>CJC accuracy (for thermocouples) shall be =< 1 deg C |
| | (ii) | For dual-input type:<br>RTD =<0.25% of 0-250 deg C span<br>T/C-K type =<0.2% of 0-600 deg C span<br>CJC accuracy (for thermocouples) shall be =< 1 deg C |

e. Field bus compatible temperature transmitters

Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets/enclosures/JBs in non-AC areas.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Air conditioned panel shall be provided for remote I/O.

Notes ***(Common for a) to d) above):-***

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

8.00.00 **E-P Converter**

E-P converters and associated accessories shall be furnished in accordance with the specifications given below :

A. Fail Freeze Type E/P convertes

| | | | |
|---|---|---|---|
| 1 | Air supply Pressure | : | 2 kg/sq. cm. |
| 2 | Input signal | : | 4-20mA DC |
| 3 | Output signal | : | 0.2 to 1.0 kg/sq. cm |
| 4 | Linearity | : | 0.5% of span or better. |
| 5 | Span/Zero Adjustment | : | To be provided |
| 6 | Hysteresis | : | 0.5% of span or better. |
| 7 | Fail Freeze Feature | : | Stay put at last position on failure of 4 –20mA signal. |
| 8 | Allowable drift rate | : | Maximum 2% set point/ hour. |
| 9 | Ambient Temperature Effect | : | less than 0.02% of span per deg C between - |
| 10 | Mounting | : | Surface/Pipe/Bracket Mounting. |
| 11 | Protection class | : | IP 65. |
| 12 | Connection Port Sizes | : | ¼ inch NPT (F) |
| 13 | Electrical Cable Entry | : | ½ inch NPT |
| 14 | Output Pressure Gauge | : | 1/4 inch NPT connection, 2 inch dial. |
| 15 | Accessories | : | All accessories like mounting brackets, fittings etc. required for installation is to be supplied. |

B. FaiL Safe type E/P converters

| | | | |
|---|---|---|---|
| 1 | Air supply Pressure | : | 2 kg/sq. cm. |
| 2 | Input signal | : | 4-20mA DC |
| 3 | Output signal | : | 0.2 to 1.0 kg/sq. cm |
| 4 | Linearity | : | 0.5% of span or better. |
| 5 | Span/Zero Adjustment | : | To be provided. |
| 6 | Hysteresis | : | 0.5% of span or better. |
| 7 | Fail Safe Feature | : | Output shall drive to minimum on failure of either 4-20mA signal or air supply. |
| 8 | Mounting | : | Surface/Pipe/Bracket Mounting. |
| 9 | Ambient Temperature Effect | : | less than 0.02% of span per deg C between -20 to +60 deg C. |
| 10 | Protection class | : | IP 65. |
| 11 | Connection Port Sizes | : | ¼ inch NPT (F) |
| 12 | Electrical Cable Entry | : | ½ inch NPT |
| 13 | Output Pressure Gauge | : | 1/4 inch NPT connection, 2 inch dial. |
| 14 | Accessories | : | All accessories like mounting brackets, fittings etc. required for installation is to be supplied. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| | | |
|---|---|---|
| | Power Supply | 230 VAC or 24VDC operated |
| | Process Temperature range | 0-200 degree Celsius |
| | Others | Drain / purging arrangement shall be provided as per standard practice. |
| | Viscosity range of Fluid | 0-500cst for HFO |

The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.

**13.00.00 SPECIFICATION FOR FLOW ELEMENTS**

**13.01.00 Orifice Plate**

| Features | Essential/Minimum Requirements |
|---|---|
| Type | Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167 |
| Material | 316 SS |
| Thickness | 3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm. |
| Material of branch pipe | Same as main pipe |
| Root valve type | Globe |
| Root valve material | Same as pipe material |
| Root valve size | 1 / 2 inch or 1 inch (as applicable) |
| Impulse pipe of same material up to root valve | Required |
| Tappings | Flanged weld neck or D & D/2 with 3 pairs of tapping ( as applicable ). Root valves to be provided in all the tappings. |
| Beta Ratio | 0.34 to 0.7 |
| Beta Ratio calculation to be submitted | Yes |
| Assembly drg. and flow Vs DP Curves | Yes |
| Accessories | Root valves, flanges, Vent/drain hole(As required) |

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**15.00.00 PROCESS ACTUATED SWITCHES**

| FEATURES | ESSENTIAL / MINIMUM REQUIREMENTS | | |
|---|---|---|---|
| | Pressure/ Draft Switches/ DP Switches | Temperature switches | Level switches |
| Sensing Element | Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum | Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application) | Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. . |
| Material | 316 SS | Bulb 316 SS/ capillary 304 SS | 316 SS |
| End connection | ½ inch NPT (F) | ½ inch NPT (F) | Manufacturer standard |
| Over range/ proof pressure | 150% of maximum operating pr. | - | 150% of maximum operating pr. |
| Repeatability | +/- 0.5% of full range | | |
| No. of contacts | 2 No.+2NC. SPDT snap action dry contact | | |
| Rating of contacts | 60 V DC, 6 VA (or more if required by DDCMIS) | | |
| Elect. Connection | Plug in socket. | | |
| Set point adjustment | Provided over full range. | | |
| Dead band adjustment | Adjustable/ fixed as per requirement of application. | | |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| | | | |
|---|---|---|---|
| Enclosure | Weather and dust proof as per IP-55, metallic housing. | | |
| Accessories | Siphon, snubber, chemical seal, pulsation dampeners as required by process | Thermo well of 316 SS and packing glands | All mounting accessories |
| Mounting | Suitable for enclosure/ rack mounting or direct mounting | Suitable for rack mounting or direct mounting | - |
| Power Supply (wherever required) | As per Contractor's Standard practice. | | |

Notes :-

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

**16.00.00 NOT USED**

**17.00.00 SOLENOID VALVES**

Solenoid valves shall fulfil the following requirements:

a. Type 2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)

b. Power supply : 24 V DC $\pm$ 10%.

c. Plug and socket electrical connection.

d. Insulation : Class 'H'

**18.00.00 REVERSE ROTATION INDICATOR (RRI)**

Reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm,

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Employer during detailed engineering. The power supply of RRI is to be arranged by the Bidder |
| **19.03.00** | All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**19.04.00 Parshall Flume**

The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totaliser and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner.

Level measurement shall be based on ultrasonic/radon technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum

Accuracy shall be +/- 1 % or better.

All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the contractor. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from rain/ sunlight etc.

The Type makes and models no. shall be subject to Owner's approval.

**19.05.00 Electronic Flow-Meter**

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.

The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feed back on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement :

| | | | |
|---|---|---|---|
| (a) | Output | : | 4-20 mA DC Isolated output |
| (b) | Accuracy | : | ± 0.5% of calibrated span or better * |
| (c) | Repeatability | : | ± 0.2% of calibrated span or better |
| (d) | Power Supply | : | 240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor. |
| (f) | Protection class | : | IP-55 |
| (e) | Flow tube | | SS304 |
| (f) | liner | | Hard Rubber |

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser/ integrator to get the daily and monthly discharge as stated above.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | |
|---|---|
| **21.00.00** | **Limit switches**<br><br>For offsite plant application Limit switches shall be gold plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.<br><br>For main plant application limit switches are to be provided as per contractor standard and proven practice. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | **CONTROL VALVES, ACTUATORS & ACCESSORIES** |
| **1.00.00** | **CONTROL VALVES, ACTUATORS & ACCESSORIES** |
| 1.01.00 | **General Requirements** |
| 1.01.01 | The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification. |
| 1.01.02 | All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves. |
| 1.01.03 | For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, refer to the corresponding mechanical sections. |
| 1.01.04 | Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification. |
| 1.02.00 | **CONTROL VALVE SIZING & CONSTRUCTION** |
| 1.02.01 | The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes. |
| 1.02.02 | The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering. |
| 1.02.03 | Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished. |
| 1.02.04 | Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, **BFP circulation control valve** shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV **as per ANSI / FCI /70.2,2006 or equivalent**. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 1.02.05 | The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers except for few cases as per contractor's standard and proven practice subject to employer's approval. |
| 1.02.06 | Control valves for steam and water application shall be provided with rangability of 30:1 for all services except for applications wherein control valves are envisaged to be operated in lower range like Reheater spray and superheater spray system wherein control valve with rangability of 50:1 shall be provided |
| **2.00.00** | **VALVE CONSTRUCTION** |
| 2.01.00 | All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit. |
| 2.02.00 | Valves with high lift cage guided plugs & quick-change trims shall be supplied. |
| 2.03.00 | Cast Iron valves are not acceptable. |
| 2.04.00 | Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable. |
| 2.05.00 | Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems. |
| 2.06.00 | All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing) |
| 2.07.00 | Valve characteristic shall match with the process characteristics. |
| 2.08.00 | Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C. |
| 2.09.00 | Flanged valves shall be rated at no less then ANSI press class of 300 lbs. |
| **3.00.00** | **VALVE MATERIALS** |

| Sr. No. | Service | Body material | Trim Material |
|---|---|---|---|
| 1 | Non-corrosive, non-flashing and non-cavitation service except DM water | Carbon steel ASTM-A216 Gr. WCB for design fluid temperature below 275 Deg. C<br>Alloy steel ASTM-A217Gr. WC6 for design fluid temperature above 275 Deg. C and upto 400 Deg. C<br>Alloy steel ASTM-A217Gr. WC9 for design fluid temperature above 400 Deg. C | 316SS stellited with stellited faced guide posts and bushings. |
| 2. | Severe flashing/cavitation services | Alloy steel ASTM-A217 Gr. WC9 | 440 C |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| 3. | Low flashing/cavitation service | Alloy steel ASTM-A217 Gr. WC6 | 17-4 PH SS |
| 4. | DM water service | 316 SS | 316 SS |

NOTE: (a) Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

(b) Severe flashing / cavitation services includes as a minimum all control valves whose downstream piping is connected to condenser or flash tank.

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

Contractor shall ensure that all required measures like proper selection of anti-corrosive/erosive material along with durable epoxy coating with polyurethane finish shall be provided for all the C&I equipment/ devices being supplied in this contract, which are mounted in non-AC areas (prone to sea water environment corrosion / erosion) like measuring instruments, control valves & actuators, JBs, LIEs / LIRs, impulse pipes, sample pipes, fittings, conduits, cable trays and accessories, local control panels, erection hardware items etc. Contractor shall furnish their comprehensive proposal regarding the anti-corrosion/ erosion measures for protection against sea water environment which shall be finalized during detailed engineering subject to Employer's approval.

**4.00.00 END PREPARATION**

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

**5.00.00 VALVE ACTUATORS**

All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**6.00.00** **CONTROL VALVE ACCESSORY DEVICES**

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

**7.00.00** **SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER**

| | | | |
|---|---|---|---|
| 1 | Electrical | a) Input Demand Signal | 4-20 mA |
| | | b) Power Supply | Loop Powered from the output card of Control System. |
| | | c) HART Protocol | Compatibility for Remote Calibration & Diagnostics (Super-imposed HART signal on input Signal (4-20 mA) |
| | | d. Valve position sensing | Position sensing, 4-20 mA output signal to be provided for control system. |
| 2 | Environment | a) Operating temp. | (-)30 To 80 Deg. C |
| | | b) Humidity | 0-95 % |
| | | c) Protection class | IP-65 Minimum |
| 3 | Software for Configuration and Diagnostics | Software | Software shall meet the requirements for Configuration, Diagnostics, Calibration and Testing of the actuator. |
| | | Diagnostic/Test features | Advanced diagnostic features like Stroke counter or Travel counter, Leakage in actuators, Valve Signature analysis, Step Response test, Valve friction /Jamming detection etc to be provided. |
| 4 | Test reports/ Certificates | Factory Valve Signature Tests Reports (Pr Vs Valve travel and Travel Vs I/P signal) are to be provided. | |
| | | Test certificates as per Manufacture Standard/Relevant Standard are to be submitted. | |
| 5 | Configuration/ Calibration. | Remote & Local Calibration, Auto & Manual Calibration shall be possible. | |
| 6 | Operating Range | Full range/ Split range. | |
| 7 | Modes | Valve Action | Direct / Reverse Valve Action |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | |
|---|---|---|---|
| | | Flow Characterization | Possible to fit Valve Characteristic Curves- Linear , Equal percentage etc. |
| 8 | Fail Safe/Fail Freeze | Fail Safe/Fail Freeze feature is to be provided. (In case the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit). | |
| 9 | Pneumatic | Air capacity | Sufficient to handle the valves & actuators selected/ Boosters to be supplied, if required. |
| | | Air pressure | To suit the air supply pressure/quality available. |
| | | Process connection | ¼" NPT |
| 10 | Performance | Characteristic deviation | <=0.5 % of span. |
| | | Ambient temp effect | <=0.01 %/ deg C or better. |
| 10 | EMC & CE Compliance | Required to International Standard like EN/IEC. | EN50081-2 & EN50082 or equivalent. |
| 11 | Accessories | In-built Operator Panel | Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock). |
| | | Hand Held Hart Calibrator | Universal Hart Calibrator to be provided (for quantity, refer Part-A: Contract quantities of the specification). |
| | | Press Gauge Block | For supply & output pressures, Air Filter Regulator and other accessories shall be provided on as required basis for making system complete. |
| | | Electrical Cable Entry | 1/2'"NPT, side or bottom entry to avoid water |

| | | | |
|---|---|---|---|
| | | | ingress. |
| | | Valves Mounting Assembly | For Sliding Stem/Rotary/Single acting/Double acting actuators on as required basis |

*** Note**:

The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned HART management system specification are mentioned in HART system (Annexure IIIC-02C to DDCMIS).

The positioners shall be monitored from this HART management system .To achieve this, Bidder shall provide the necessary software to achieve the functionalities described above under " Software for Configuration and Diagnostics", and this software shall be loaded in the HART management system.

**8.00.00** **TEST AND EXAMINATION**

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34/ FCI 70.2 standard and as per the leakage class indicated above

8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

8.05.00 CV Test: Please refer Cl No. 1.00.00 & 3.00.00 OF Sub-section- IIIC-10 (Type test requirements), Control Valves.

Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB–SECTION – B-23

## VFD

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**1.00.00 CODES AND STANDARDS**

| | |
|---|---|
| DC Reactor | IEC: 60289 |
| Motor | IS: 4722/IS: 325/IEC: 60034/NEMA 30 & 31 |
| Transformer | IEC: 60076/IS: 2026, IEC: 61378 |
| Dry transformer | IS: 11171 |
| VFD | IEC: 60034/ IEC: 61800 |
| Harmonics & EM compatibility | IEEE: 519/IEC: 61000 |
| Contactor/Switches/Fuses etc. | IEC: 60947, IS: 13947 |

**2.00.00 OPERATING CONDITIONS**

2.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered.

2.02.00 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

2.03.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

2.04.00 The auxiliary AC voltage supply arrangement shall have 11/6.6/3.3kV and 415V systems (as applicable). It shall be designed to limit voltage variations as given below under worst operating condition:

1. 11kV/ 3.3 kV/ 6.6 KV : +/- 6%
2. 415V : +/- 10%

Note: The Voltage level mentioned above is the Nominal Voltage available at the input of the VFD System from the MCC/ Switchgear/transformer, based on the system requirement/Availability.

The voltage level for the VFD shall be as follows:-

1. Upto 400 kW : 415V/690V, Low Voltage, Three Phase AC
2. Above 400kW and upto 700 KW : 690V, Low Voltage, Three Phase AC
3. Above 700KW and upto 1500 KW : Medium Voltage, Three Phase AC

Note: The voltage level mentioned above is the Nominal Voltage which is fed to the motor from the VFD.

From here onwards in the specifications all the VFD Systems consisting of either 415 V or 690 V may be termed as LV VFD while the higher rated VFD System shall be termed as MV VFD. If nothing is mentioned than the Clause is applicable for both the LV and the MV VFD until deliberated otherwise.

2.05.00 For Power Cables & Control Cables, please refer technical specification given elsewhere in the document.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **3.00.00** | **SYSTEM DESCRIPTION** |
| 3.01.00 | The VFD System shall include the following equipment for each drive.<br>a) Power/control panels consisting of line converters, inverters and control system for drive including complete control & protection of drive and the motor.<br>b) VFD transformer on the source side, as per system requirement.<br>c) Breaker/Contactor on the VFD/Motor/Transformer/CT/PT/Meters/Bypass (if applicable) side with complete Control, Protection and Diagnostics features of the VFD, as per system requirement.<br>d) Bypass Arrangement of the VFD system if specified.<br>e) DC air core reactor or capacitor, as per the system requirement.<br>f) Inverter Duty Motor suitable for VFD application<br>g) Power & control cables and cabling as required under the scope of supply in the technical specifications. |
| 4.00.00 | **GENERAL REQUIREMENTS** |
| 4.01.00 | **Medium Voltage VFD**: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum eighteen (18) pulse design. |
| 4.02.00 | **415 V/690 V LV VFD:** The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum Twelve (12) pulse design. For drives less than 100 KW Six (6) pulse can be offered meeting all other requirements. |
| 4.03.00 | The system shall be fully digital, PLC/Microprocessor based, energy efficient, and shall provide very high reliability, high power factor, low harmonic distortion and low vibration and wear and noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance. |
| 4.04.00 | The offered equipment shall be with state of art technology and proven field track record. No prototype equipment shall be offered. |
| 4.05.00 | The VFD model offered shall be from the existing VFD model series in the regular manufacturing range of the manufacturer. Along with the offer the Vendor shall submit the supply record and satisfactory performance record for **2 (two)** years running of the offered VFD supplied in India or abroad. |
| 4.06.00 | The VFD manufacturer shall ensure the proper coordination of their VFD with the Driven Motor and the Employer`s system. All the Motors which are to be driven by VFDs will be of Inverter duty type. The VFD operation shall have no inherent detrimental impact on the Motors/ cables & employer`s system. |
| 4.07.00 | Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least for 15 years from the date of supply. After this period, if vendor |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | discontinues the production of spare parts, vendor shall give at least twelve (12) months' notice prior to such discontinuation so that owner may order his requirements of spares in one lot. The offered VFD manufacturer should have their maintenance service & spares supply network in India to provide quick maintenance service & Spares supply support. The vendor shall indicate the source for supply of spares & Maintenance service location in India. |
| **5.00.00** | **TECHNICAL AND OPERATIONAL REQUIREMENTS** |
| 5.01.00 | The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with maximum input supply voltage and frequency variation. The system shall be suitable for the load characteristics and the operational duty of the driven equipment. |
| 5.02.00 | The overload capacity of the controller shall be 150% of the rated current of the motor for one minute for constant torque applications and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. |
| 5.03.00 | The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified by the load:<br><br>a. Variable torque changing as a function of speed.<br><br>b. Constant torque over a specific speed range.<br><br>c. Constant power over a specific speed range.<br><br>d. Any other as specified in data-sheet |
| 5.04.00 | VFDs shall comply with the latest edition of IEEE 519 & IEC 61000 for both individual as well as total harmonic voltage and current distortion limits. The Voltage and Current limits shall be applicable at the Point of Common Coupling (PCC), which shall be the MCC/ Switchgear/ from which the VFD system is fed. |
| 5.05.00 | The compliance shall be verified by the contractor by Harmonic studies conducted with maximum and minimum fault level, cable capacitance, system equipment reactance etc. Finally, the compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation. |
| 5.06.00 | VFD shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit. Any damage resulting from such a short circuit or internal fault shall be limited to the component concerned. |
| 5.07.00 | The system shall be suitable to maintain speed variation within range 10-110% with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement. |
| 5.08.00 | The VFD System shall maintain a power factor of 0.95 (minimum) from 25 % to 100 % of rated speed. |
| 5.09.00 | Maximum allowable audible noise from the VFD system will be 85 dB (A) at a distance of one meter under rated loaded with all cooling fan operating conditions. |
| **6.00.00** | **VFD COMPATIBILITY WITH THE MOTOR** |
| 6.01.00 | For MV VFD Drives, to ensure that there are no problems with motor heating, VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads, |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | with a total harmonic current and voltage distortion within acceptable/standard limits. VFD utilizing output transformers are not acceptable. |
| 6.02.00 | The system design shall not have any inherent output harmonic resonance in the operating speed range. |
| 6.03.00 | VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor. The vendor shall clearly state the limitations in the motor cable distance in his proposal. However, due to system requirements & constraints if the cable length becomes critical, filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics. |
| **7.00.00** | **BYPASS ARRANGEMENT (OPTIONAL, IF SPECIFIED)** |
| 7.01.00 | The VFD System shall have an optional feature to run the motor under bypass arrangement for operation of Motor with VFD bypassed. During starting (under rated conditions) the motor will be switched on in VFD Mode to limit the starting current and after gaining speed, the load would be switched over to bypass mode. |
| 7.02.00 | Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering. |
| 8.00.00 | **STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)** |
| 8.01.00 | A Common standby arrangement with auto/manual switchover shall be provided in case of failure of any VFD in a group of drives. Complete protection, interlocks & control required shall be provided in the changeover module. |
| **9.00.00** | **EFFICIENCY** |
| 9.01.00 | Efficiency ( Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency shall be minimum 96.5% for both MV and LV VFD at rated load and speed. Overall Efficiency evaluation shall include input transformer, harmonic filters and power factor correction (if applicable), VFD converters, cooling fans and output filter, as applicable in the system. Auxiliary controls, such as internal VFD control boards, cooling fans/pumps. |
| 9.02.00 | In absence of valid test report, a factory test shall be performed at the VFD manufacturer's facility verifying the efficiencies. Manufactures who are supplying Drive and transformer from different locations, efficiency test will be conducted separately for Drive and transformer. |
| **10.00.00** | **COOLING SYSTEM** |
| 10.01.00 | The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95%. |
| 10.02.00 | VFD manufacturer to primarily offer Air cooled Design. However in case of large ratings, liquid cooled drives may be accepted subject to employer's approval. In case of liquid cooled system, there shall be no necessity of continuous water supply system. |
| 10.03.00 | In case of Air cooled design, the VFD Cooling system shall be such that it puts minimum heat load inside the room and preferably throw the hot air outside the room with ventilation ducts. The Cooling system shall be designed in such a way that the Air Conditioning & Ventilation Air requirements are kept to minimum. The VFD Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering. |
| 10.04.00 | Air cooled VFDs shall be provided with cooling fans mounted integral to the VFD/ enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure. |
| **11.00.00** | **VFD TRANSFORMER:** |
| 11.01.00 | Type: Out door, Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer. |
| 11.02.00 | Transformer shall be suitable for operation with non-sinusoidal wave shape and DC components under normal and abnormal conditions of the system without exceeding the temperature. |
| 11.03.00 | Suitable Design Margin as per applicable standards shall be taken for purpose of sizing of the transformer. |
| 11.04.00 | All other components, technical parameters shall be as per applicable IEC/IS. |
| **12.00.00** | **POWER CONVERTER:** |
| 12.01.00 | The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type. |
| 12.02.00 | The converter shall be co-ordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation. |
| 12.03.00 | Adequate short circuit and over voltage protection shall be provided for the converter and inverter system. |
| 12.04.00 | All power converter devices shall include protective devices, snubber networks and dv/dt networks as required. |
| 12.05.00 | The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. If the parallel connection of semiconductor is applied, the above current rating shall not be less than 140% of the above values. |
| 12.06.00 | All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage. |
| 12.07.00 | The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools. |
| 12.08.00 | The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices. |
| **13.00.00** | **OUTPUT FILTER (AS APPLICABLE):** |
| 13.01.00 | Output/ du/dt filter shall be provided, if required. It shall be an integral part of the VFD system and included within the VFD enclosure. It shall inherently protect motor from high voltage dv/dt stress. |
| **14.00.00** | **DC LINK CAPACITOR (AS APPLICABLE):** |
| 14.01.00 | Capacitor shall be of self-healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have discharge resistors |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.

**15.00.00 ENCLOSURE**

15.01.00 Enclosure frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.

15.02.00 The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.

15.03.00 All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 4X as per IS/IEC 60947.

15.04.00 Enclosures must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.

15.05.00 Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.

**16.00.00 PAINTING**

Paint shade shall be as follows

| | | | |
|---|---|---|---|
| a) | VFD transformer | : | RAL 9002 (Grey), legend in black letter |
| b) | Motors | : | RAL 5012 (Blue) |
| c) | VFD Panels | : | Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012) |
| d) | VFD reactor enclosure | : | RAL 5012 (Blue), legend in black letter |

**17.00.00 BREAKER/CONTACTOR**

17.01.00 **Type:** Shall be SF6 or Vacuum type or air-break restrike free, stored energy operated and with electrical anti-pumping features.

17.02.00 These shall be electrically operated, mechanically latched type & shall have protection against over load, all AC/DC transients and voltage surges etc. Electronic control module shall be electrically isolated.

17.03.00 All other components, technical parameters shall be as per applicable IEC/IS.

**18.00.00 MOTORS**

18.01.00 VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side.

18.02.00 Motors shall also meet the requirements mentioned in subsection for motors and relevant IS/IEC.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 18.03.00 | Motor shall be suitable for operation with a solid state power supply consisting of an adjustable frequency inverter for speed control & shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive. |
| 18.04.00 | Motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800. |
| 18.05.00 | Drive manufacturer shall coordinate with the motor manufacturer for proper selection of the motor for the given load application and the output characteristics of the drive. |
| **19.00.00** | **CABLES & CABLING** |
| 19.01.00 | All the power cable for the VFD System shall have sufficient current capacity and shall be suitably sized to meet the load demand on the motor. |
| 19.02.00 | VFD Manufacturer shall submit cable sizing & selection criteria of drive cables including grounding/ earthing philosophy to address all the key issues such as EM Noise emissions, Common mode noise, voltage reflections, stray capacitances etc., for owner`s review and approval. |
| 19.03.00 | Cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. The instrumentation and other control cables susceptible to interference shall be routed separately from the Power Cables. |
| 19.04.00 | For other control/instrumentation Cables and other components, technical parameters shall be as per applicable IEC/IS/Mentioned Elsewhere in the specifications. |
| **20.00.00** | **CONTROL AND PERFORMANCE REQUIREMENTS** |
| 20.01.00 | The VFD to provide an automatic current limiting feature to control motor currents during startup and provide a “soft start” torque profile for the motor load combination. Current and torque limit adjustments shall be provided to limit the maximum VFD output current and the maximum torque produced by the motor. |
| 20.02.00 | It shall be possible to vary the speed of the drive and control it in either Local or Remote mode. Local / Remote selection shall be done from VFD panel unless otherwise specified. |
| 20.03.00 | Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS. |
| 20.04.00 | Drive shall be equipped with a front mounted operator console panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter. Control panel shall be operable with password for changing the protection setting, safety interlock etc. |
| 20.05.00 | Operator console/Main Control Card shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another drive for start up and operation. |
| 20.06.00 | User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning. |
| **21.00.00** | **PROTECTION FEATURES** |
| 21.01.00 | The system offered shall incorporate adequate protection features, properly coordinated for the drive control and for motor including following: |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection.<br>ii) Incoming and outgoing line surge protection.<br>iii) Under / over voltage protection<br>iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection.<br>v) Instantaneous Over current & Earth fault protection<br>vi) Converter/Inverter module failure indication.<br>vii) Over frequency/speed protection.<br>viii) Ventilation failure indication & alarm.<br>ix) Over temperature of VFD<br>x) Bearing temperature protection.<br>xi) System earth fault protection.<br>xii) Speed reference loss protection. |
| 21.02.00 | Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable. |
| **22.00.00** | **CONTROL FEATURES** |
| 22.01.00 | Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door.<br>i) Start / stop (in local/remote mode)<br>ii) Speed control (Raise / lower)<br>iii) Acknowledge/Accept/ Test Push Button for annunciation<br>iv) Auto / Manual / Test Mode select<br>v) Emergency stop<br>vi) Trip-Remote Breaker |
| 22.02.00 | **DIAGNOSTIC FEATURES** |
| 22.02.01 | The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions. |
| 22.02.02 | Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose. |
| 22.03.00 | **SERVICEABILITY / MAINTAINABILITY** |
| 22.03.01 | Front Access: VFD system should be designed for front access only. Manufacturer shall state in his proposal if rear access is provided. |
| 22.03.02 | Power Component Accessibility: All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime. |
| 22.03.03 | Marking / Labeling: Sleeve type wire marker tags or other acceptable means of permanent identification shall be applied to power and control wiring. Individual labels shall be provided for all major components of the VFD system. |
| 23.00.00 | **STORAGE AND PRESERVATION** |
| 23.01.00 | The Contractor shall be responsible for the storage and preservation of all the equipments to be supplied under the VFD System, till the time of successful installation and commissioning. The equipment should be suitable for storage for long periods before installation. Contractor should take adequate measures to ensure that no damage happens to the VFD System due to storage and preservation. Vendor shall submit powering requirement (if any) during storage. |
| **24.00.00** | **TESTS** |
| 24.01.00 | **ROUTINE TESTS**<br><br>All acceptance and routine tests as per the specification and standard IEC -61800-2 and IEC 61800-4 shall be carried out. |
| 24.02.00 | **TYPE TESTS**<br><br>The Contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Employer and submit the reports for approval. |
| 24.02.01 | **LIST OF TYPE TESTS**<br><br>a) VFD panels (For LV VFD)<br>i. Rated Current/ Output<br>ii. Temperature rise test<br>iii. Surge withstand capability test<br>iv. Noise level test<br>v. Power Loss Determination Test<br>vi. Power factor measurement. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

vii. Degree of Protection Test

viii. EMC Test

b) VFD Panels (For MV VFD)

i. Rated Current/ Output

ii. Current Sharing

iii. Voltage Division

iv. Temperature rise test

v. Surge withstand capability test

vi. Noise level test

vii. Power Loss Determination Test

viii. Power factor measurement.

ix. Degree of Protection Test

c) AC/DC Reactor (If applicable)

i. Lightning impulse test

ii. Heat run test

iii. Short time current test

iv. Noise level test

d) Induction motors

i. As per requirements mentioned in subsection for motor.

e) VFD transformers

i. As per requirements mentioned in subsection for Transformer/ IEC 60076/IS 2026

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# DATA SHEETS FOR MOTORISED VALVE ACTUATOR

| | | |
|---|---|---|
| BHEL | **SPECIFICATION FOR MOTORISED VALVE ACTUATOR** | REV. NO. 01 / DATE: 11.05.2018 |
| | | SHEET 1 OF 4 |

## Data Sheet A & B

| | DATA SHEET-A (TO BE FILLED BY PURCHASER) | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) |
|---|---|---|
| **GENERAL*** | * PROJECT | 3 x 800 MW PATRATU TPP |
| | OFFER REFERENCE | |
| | * TAG NO. SERVICE | |
| | * DUTY | ☐ ON / OFF ☐ INCHING |
| | * LINE SIZE (inlet/outlet): MATERIAL | |
| | * VALVE TYPE | ☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ 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 90% 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 | ■ YES ☐ NO |
| | * ORIENTATION | ☐ TOP MOUNTED ☐ 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-INCLUSIVE OF **I.S.** TOLERANCE |
| | ACTUATOR APPLICABLE WIRING DIAGRAM | ■ ENCLOSED (BIDDER TO CONFIRM)<br>A: ☐ DRG. NO. 3-V-MISC-24227 R00<br>B: ☐ DRG. NO. 3-V-MISC-24550 R00<br>C: ☐ DRG. NO. 3-V-MISC-24283 R00<br>D: ☐ DRG. NO. 4-V-MISC-90271 R11<br>E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram |
| | COLOUR SHADE | ■ BLUE (RAL 5012) ENAMEL ☐ ..... |
| | PAINT TYPE **(## Refer Notes)** | ☐ ENAMEL ☐ EPOXY ☐ ..... |
| | SHAFT RPM | BIDDER TO SPECIFY |
| | OLR SET VALVE | 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 +/- 10 % , 3PH,3 W, AC 50 HZ +/- 5 % |
| | @ CONTROL VOLTAGE REQUIREMENT | TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ■ 110 V AC/24V DC |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| BHEL | **SPECIFICATION FOR MOTORISED VALVE ACTUATOR** | REV. NO. 01 / DATE: 11.05.2018 |
| | | SHEET 2 OF 4 |

## Data Sheet A & B

| | DATA SHEET-A (TO BE FILLED BY PURCHASER) | | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) |
|---|---|---|---|
| | MOTOR BEARING WITH 2 EARTH TERMINALS | DOUBLE SHIELDED, GREASE LUBRICATED ANTI FRICTION | |
| | @ ENCLOSURE CLASS OF MOTOR | IP 67 FOR OUTDOOR & IP 55 FOR INDOOR(TOTALLY ENCLOSED SELF VENTILATED) | |
| | @ INSULATION CLASS | CLASS-F TEMP. RISE LIMITED TO CLASS-B | |
| | @ WINDING TEMP PROTECTION | ■ THERMOSTAT (3 Nos.,1 IN EACH PHASE)<br>☐ ---------- | |
| | SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION | REQUIRED | |
| **INTEGRAL STARTER** | INTEGRAL STARTER | ■ REQUIRED ☐ NOT REQUIRED | |
| | TYPE OF SWITCHING DEVICE | ■ CONTACTORS ☐ THYRISTORS | |
| | TYPE | ■CONVENTIONAL ☐ SMART (NON-INTRUSIVE) | |
| | **IF SMART** | (NOT APPLICABLE) | |
| | a) SERIAL LINK INTERFACE | ☐ INTEGRAL ☐ FIELD MOUNTED | |
| | b) SERIAL LINK PROTOCOL | ☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS<br>☐ DEVICE NET ☐..... | |
| | c) SERIAL LINK MEDIA | ☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL<br>☐ OFC | |
| | d) HAND HELD PROGRAMMER | ☐ REQUIRED ☐ NOT REQUIRED | |
| | e) TYPE OF HAND HELD PROGRAMMER | ☐ BLUETOOTH ☐ INFRARED ☐..... | |
| | f) MASTER STATION | ☐ REQUIRED ☐ NOT REQUIRED | |
| | g) MASTER STN INTRFACE WITH DCS | ☐ MODBUS ☐ TCP/IP | |
| | h) DETAILS OF SPECIAL CABLE | ☐ ENCLOSED ☐ NOT REQUIRED | |
| | STEP DOWN CONT. TRANSFORMER | ■ REQUIRED | |
| | OPEN / CLOSE PB | ■ REQUIRED ☐ NOT REQUIRED | |
| | STOP PB | ■ REQUIRED ☐ NOT REQUIRED | |
| | INDICATING LAMPS | ■ REQUIRED ☐ NOT REQUIRED | |
| | LOCAL REMOTE S/S | ■REQUIRED ☐ NOT REQUIRED | |
| | STATUS CONTACTS FOR MONITORING | ■ REQUIRED ☐ 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/OPTO COUPLER** (Applicable for integral Starter) | TYPE OF ISOLATING DEVICE | ■ INTERPOSING RELAY ☐ OPTO COUPLER<br>☐ EITHER | |
| | QUANTITY | ■ 2 NOs. ☐ 3 NOs. | |
| | DRIVING VOLTAGE | ■ 20.5 – 24V DC ☐ _____V DC | |
| | DRIVING CURRENT | ■ 125mA MAX ☐ _____mA MAX | |
| | LOAD RESISTANCE | ■ > 192 ohms - <25 k ohms<br>☐ > _____ohms - < _____ohms | |
| **TORQUE SWITCH** (Not Applicable for Smart Actuator) **($$ Refer Notes)** | MFR & MODEL NO. | BIDDER TO SPECIFY | |
| | OPEN / CLOSE | ■1 No. ☐2Nos. / ■1 No. ☐2Nos | |
| | CONTACT TYPE | 2 NO + 2 NC | |
| | RATING | 5A 240V AC AND 0.5A 220V DC | |
| | CALIBRATED KNOBS(OPEN&CLOSE TS) | REQUIRED FOR SETTING DESIRED TORQUE | |
| | ACCURACY | +3% OF SET VALUE | |
| **LIMIT SWITCH (Not Applicable for Smart Actuator) ($$** | MFR & MODEL NO. | BIDDER TO SPECIFY | |
| | OPEN : INT : CLOSE | ☐1 No ■2 Nos. / ☐1 No. ■2Nos. | |
| | CONTACT TYPE | 2 NO + 2 NC | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| BHEL | **SPECIFICATION FOR MOTORISED VALVE ACTUATOR** | REV. NO. 01 / DATE: 11.05.2018 |
| | | SHEET 3 OF 4 |

## Data Sheet A & B

| | DATA SHEET-A (TO BE FILLED BY PURCHASER) | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) |
|---|---|---|

| | | | |
|---|---|---|---|
| **Refer Notes)** | RATING (AC / DC) | 5A 240V AC AND 0.5A 220V DC | |
| **Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of control system subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.** | | | |

| | | | |
|---|---|---|---|
| **POSITION TRANSMITTER** | POSITION TRANSMITTER (For inching duty applications) | ■ REQUIRED ☐ NOT REQUIRED | |
| | MFR & MODEL NO. | BIDDER TO SPECIFY | |
| | TYPE | ☐ELECTRONIC (2 WIRE) R/I CONVERTER<br>■ ELECTRONIC (2 WIRE) CONTACTLESS INDCUTIVE TYPE ,EXTERNAL 24 V DC OPERATED ,SUITABLE FOR STABILISED 4-20 mA SIGNAL | |
| | SUPPLY | ■ 24V DC ☐ ..... | |
| | OUTPUT | ■ 4-20mA | |
| | ACCURACY | ± 1% FS | |
| **SPACE HEATER** | @SPACE HEATER | REQUIRED | |
| | @ POWER SUPPLY (NON INTEGRAL) | 230V AC,1 PH.,50 Hz | |
| | @ POWER SUPPLY (INTEGRAL) | POWER SUPPLY DERIVED FROM MAIN POWER SUPPLY AVAILABLE AT ACTUATOR END. | |
| | @ RATING | | |
| **TERMINAL BOX** | ACTUATOR/MOTOR TERMINAL BOX | REQUIRED | |
| | ENCL CLASS ACTUATOR/MOTOR T.B. | ■ IP 68 @☐..... | |
| | @ EARTHING TERMINAL | REQUIRED | |
| | PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT) | ■ REQUIRED ☐ NOT REQUIRED☐<br>■ 2 NOS. PRE WIRED ☐ ---------- | |
| **CABLE GLANDS** | @ POWER CABLE GLAND | SIZE:---------- | |
| | @ SPACE HEATER CABLE GLAND | SIZE:---------- | |
| | OTHER CONTROL CABLE GLANDS-1 | 2 NOS SUITABLE FOR 4P,0.5SQ MM | |
| | OTHER CONTROL CABLE GLAND | 1 No. for BFV of CW PUMP(Cable size 2Px1.5mm2) | |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | |
|---|---|---|
| BHEL | **SPECIFICATION FOR MOTORISED VALVE ACTUATOR** | REV. NO. 01 / DATE: 11.05.2018 |
| | | SHEET 4 OF 4 |

## Data Sheet A & B

| DATA SHEET-A (TO BE FILLED BY PURCHASER) | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) |
|---|---|

| | | | |
|---|---|---|---|
| **WEIGHT** | TOTAL WEIGHT (ACTUATOR + ACCESSORIES) | BIDDER TO SPECIFY | _____ Kg. |

**NOTES**:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION 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
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. 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.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 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%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

**$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**

**## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

8. IT SHALL BE POSIIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
9. POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL
10. WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE.

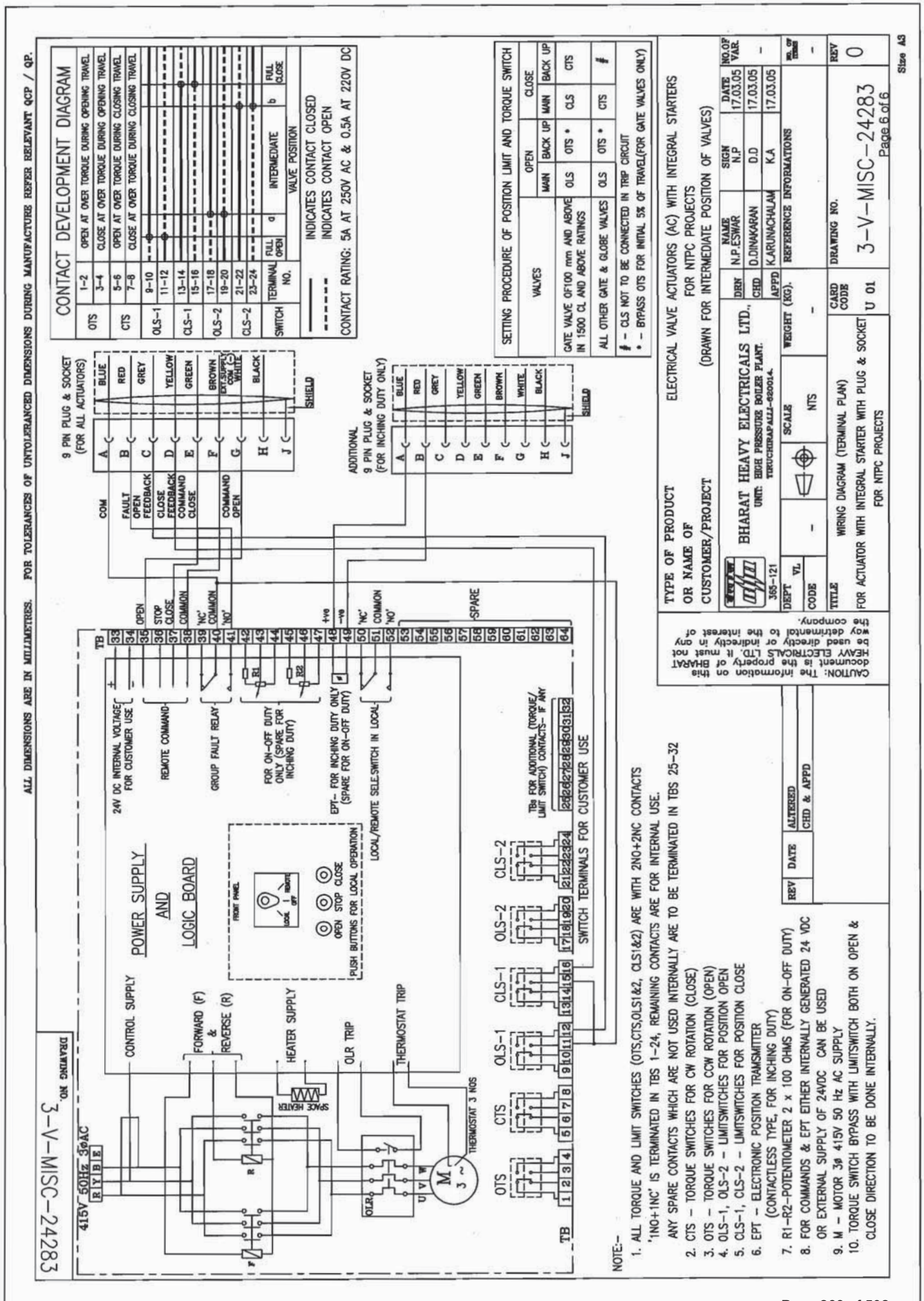
.

| | PREPARED BY | CHECKED BY | APPROVED BY | VENDOR COMPANY SEAL |
|---|---|---|---|---|
| NAME | Madhav gupta | Mayank kesharwani | Bharat Singh | NAME |
| SIGNATURE | | | | SIGNATURE |
| DATE | 01.03.02018 01. | 03.2018 | 01.03.2018 | DATE |

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

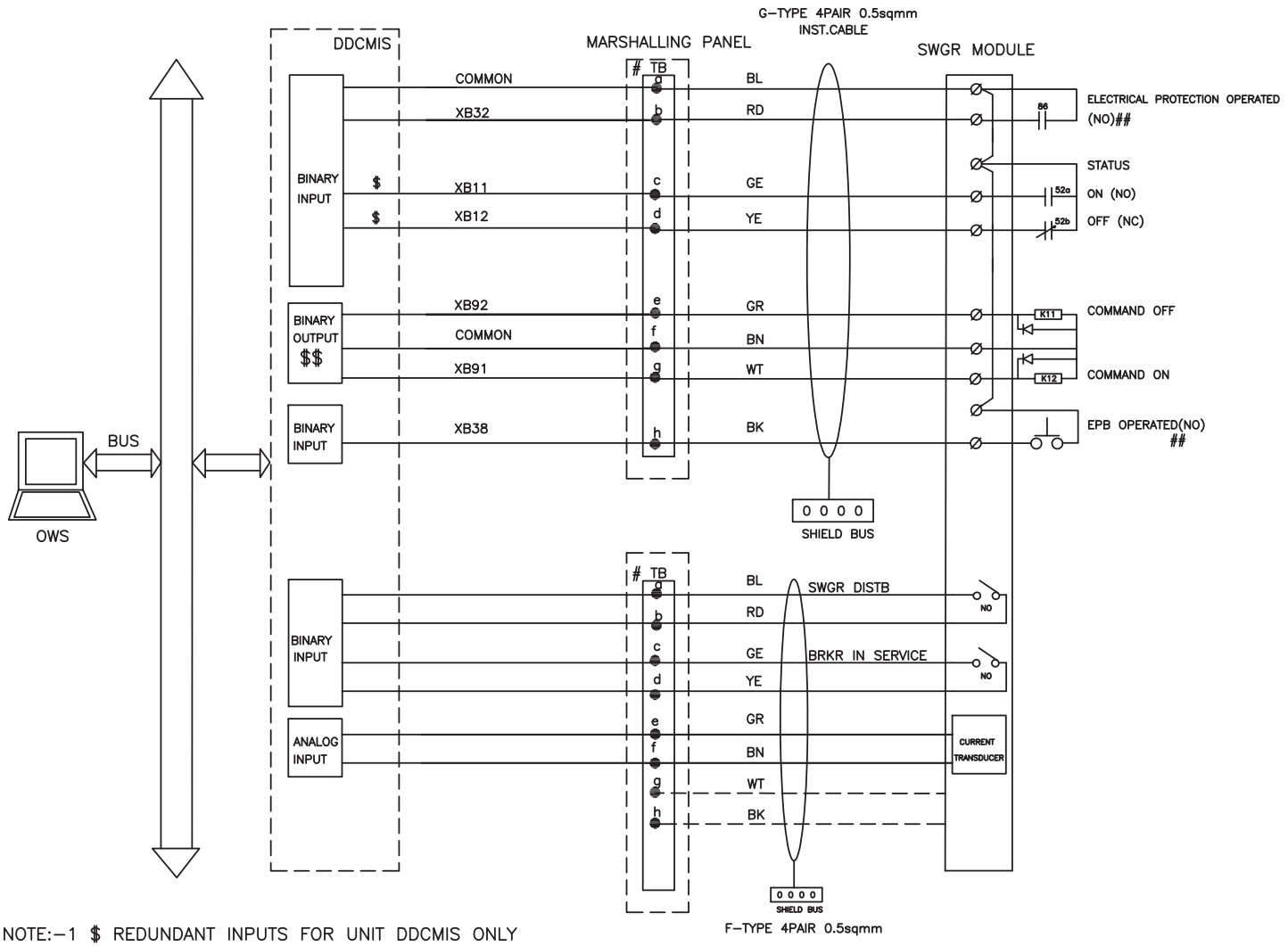
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SIGNL EXCHANGE BETWEEN DRIVES & DCS

# DDCMIS INTERFACE WITH HT SWITCH GEAR (HT)




06

NOTE:–1 $ REDUNDANT INPUTS FOR UNIT DDCMIS ONLY

NOTE:–2 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

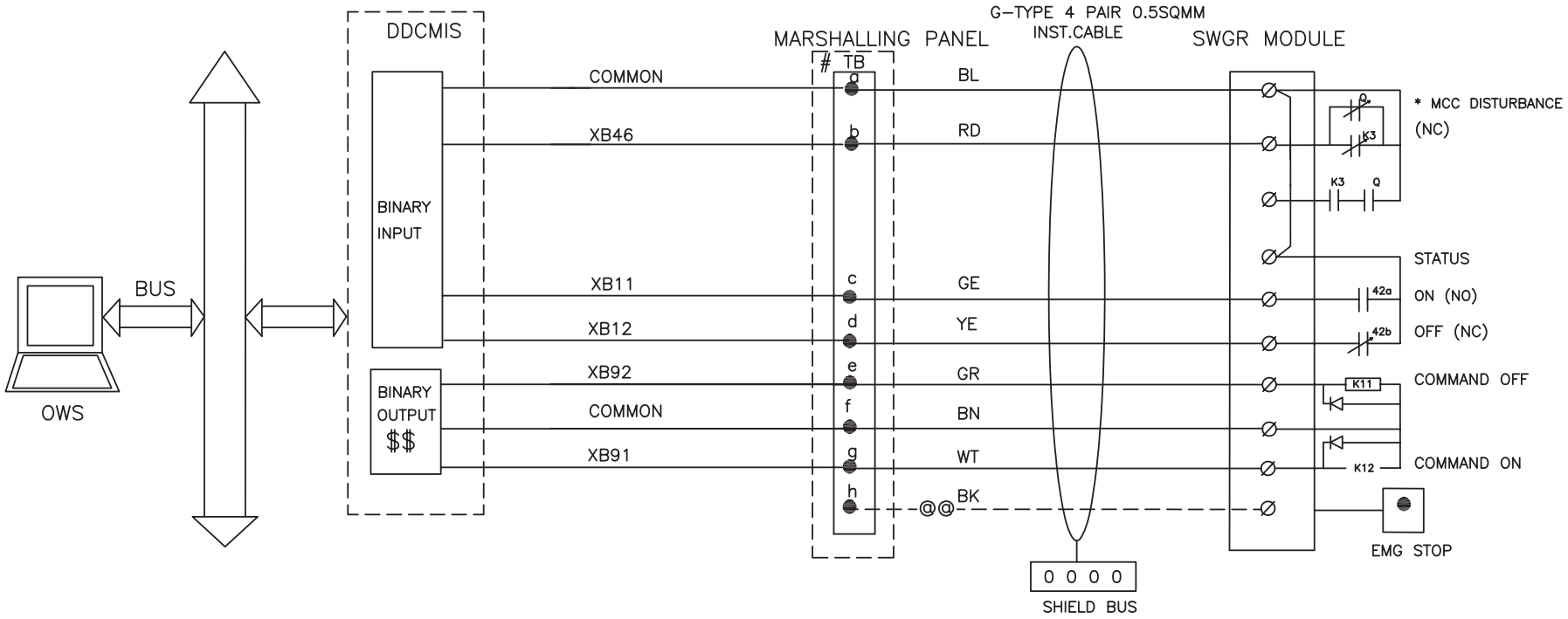
NOTE:–3 # 8 LEVEL TERMINAL BLOCK

NOTE:–4 ## DI–SOE SIGNALS FOR UNIT DDCMIS ONLY

NOTE:–5 CURRENT SIGNAL IS TO BE CONSIDERED IN DDCMIS FROM HT BREAKER FOR FD,ID,PA,MILL MOTORS, CHP HT CONVEYORS,BFP,CEP, HT DRIVES FOR FGD

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE–I | DRG.NO. | 9585–001–405–PVI–B–152B |
| | DDCMIS INTERFACE WITH HT SWITCH GEAR(HT) | SH | 04 OF 34 |

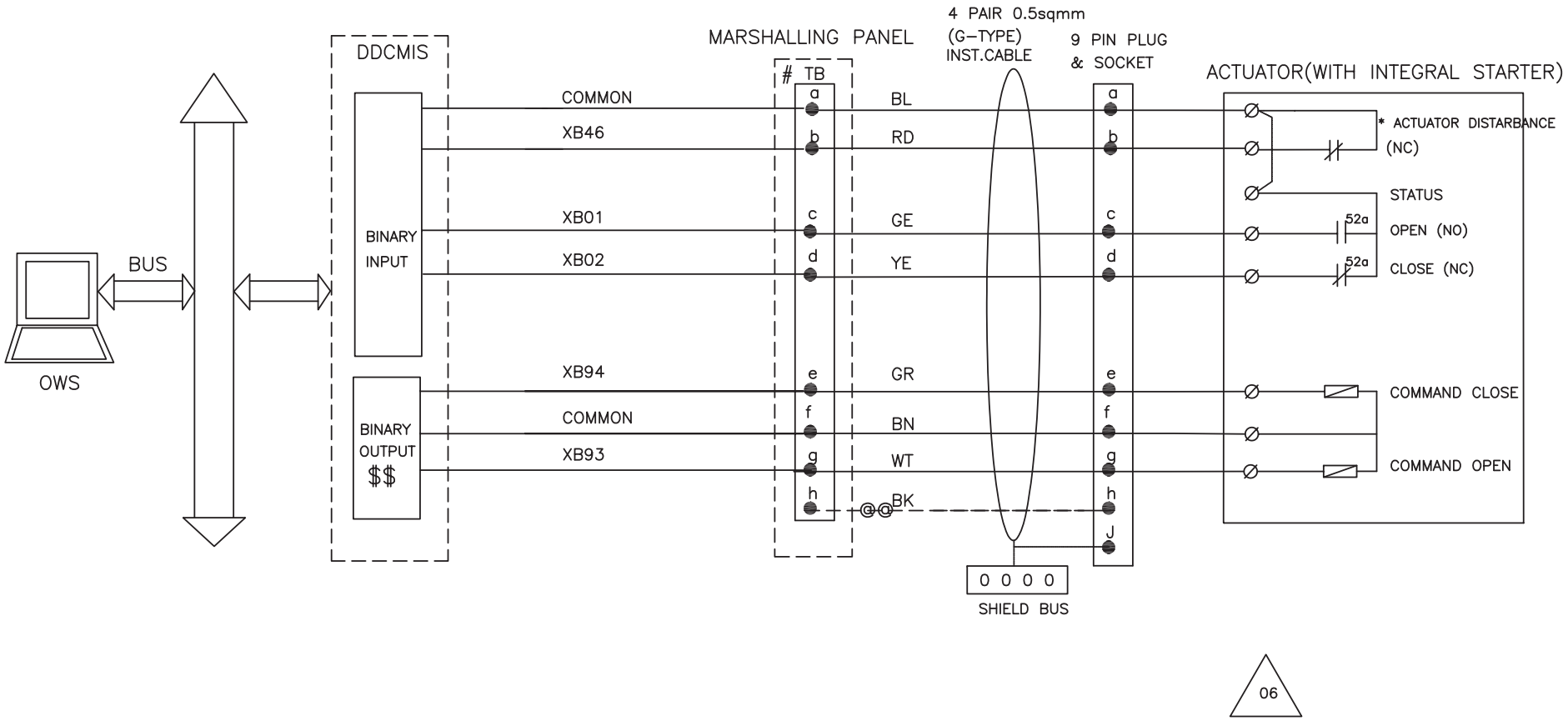
# DDCMIS INTERFACE WITH LT MCC (LT)




NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION SEQUENTIALLY.
NOTE:-4 * MCC DISTURBED= THERMAL O/L OPT/CONT SUPP FAIL/EPB OPTD /DRIVE POWER SUPPLY OFF

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE-I | DRG.NO. | 9585-001-405-PVI-B-152B |
| | DDCMIS INTERFACE WITH LT MCC (LT) | SHT | 05 OF 34 |

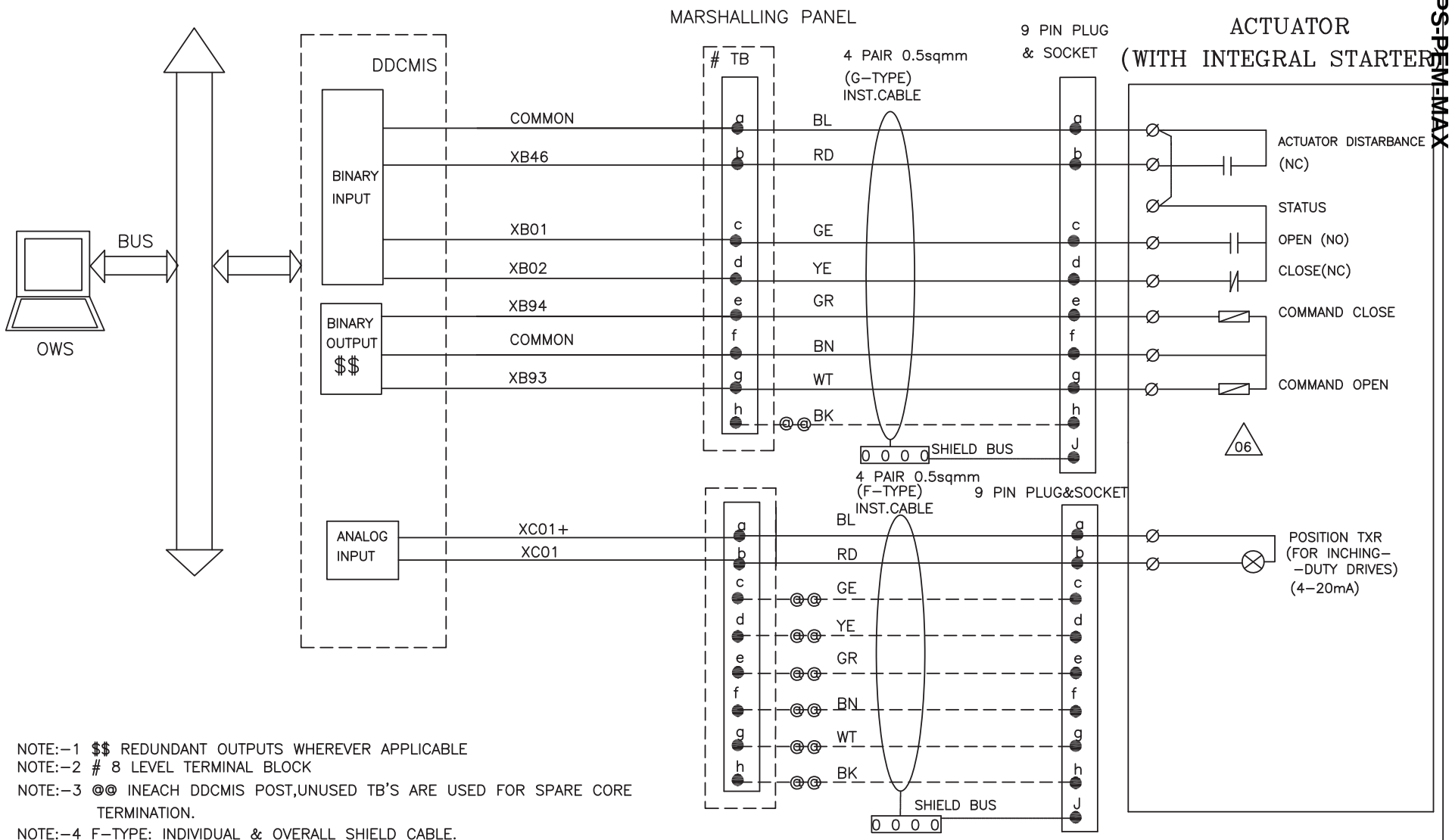
# DDCMIS INTERFACE WITH BID/MOV/MOD




NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * DISTURBANCE=LOSS OF POWER SUPPLY(1PHASE/3PHASE)/LOSS OF CONTROL SUPPLY/MOTOR THERMOSTAT TRIP/THERMAL OVER LOAD/ TORQUE SWITCH OPERATED, LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE-I | DRG.NO. | 9585-001-405-PVI-B-152B |
| | DDCMIS INTERFACE WITH BID | SHT | 06 OF 26 |

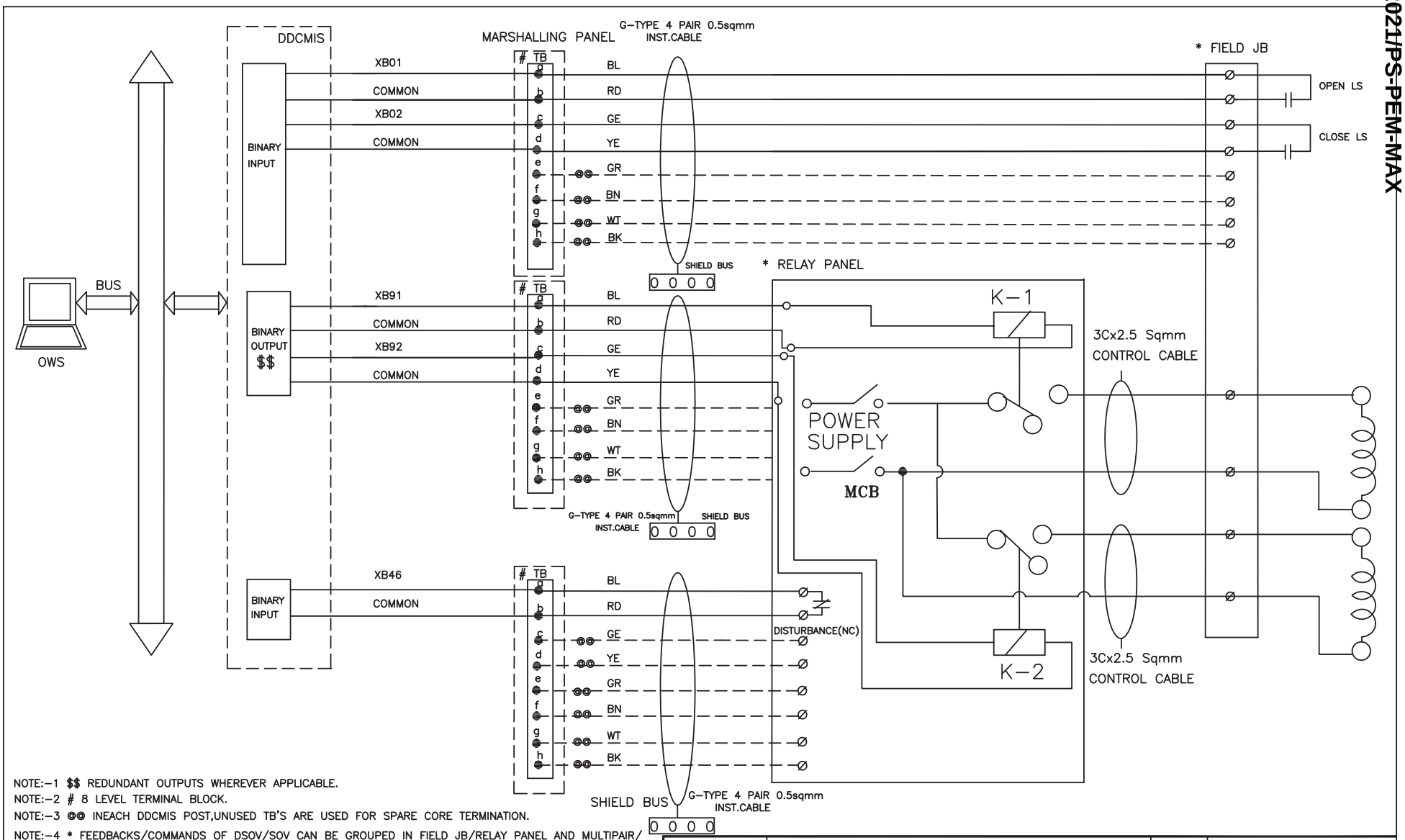
# DDCMIS INTERFACE WITH BIDI/MODI/MOVI




NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.
NOTE:–5 *DISTURBANCE=LOSS OF POWER SUPPLY/LOSS OF CONTROL SUPPLY/ MOTOR THERMOSTAT TRIP/THERMAL OVERLOAD/TORQUE SWITCH OPTD/ LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE–I | DRG.NO. | 9585–001–405–PVI–B–152B |
| | DDCMIS INTERFACE WITH BIDI | SHT | 07 OF 34 |

# DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)



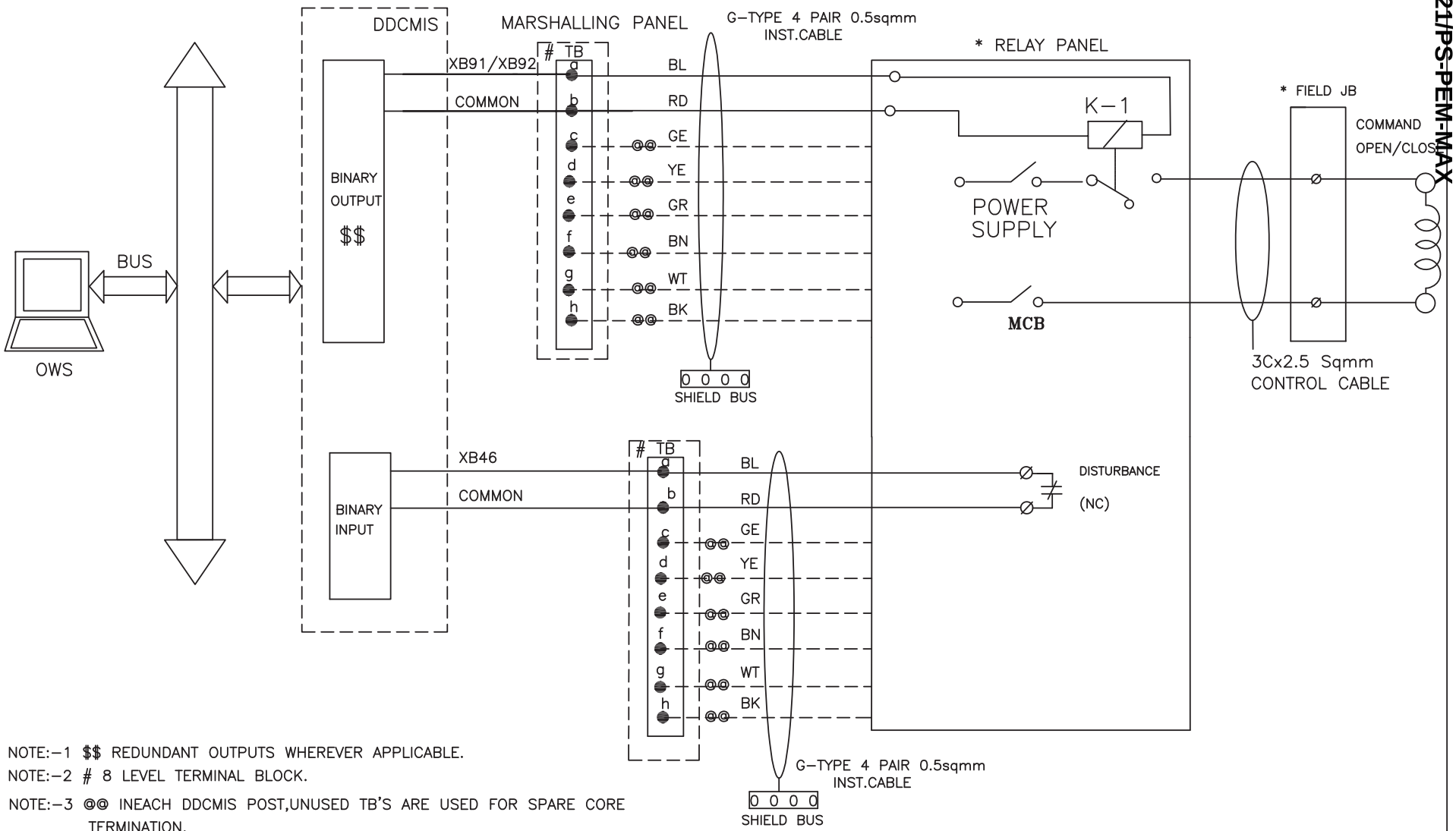

NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.
NOTE:-6 TWO INDEPENDENT OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES,WITH DUAL COIL SOLENOIDS.

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE-I | DRG.NO. | 9585-001-405-PVI-B-152B |
| | DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L) | SHT | 10 OF 34 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



# DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)




NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:-2 # 8 LEVEL TERMINAL BLOCK.

NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHELING PANEL.

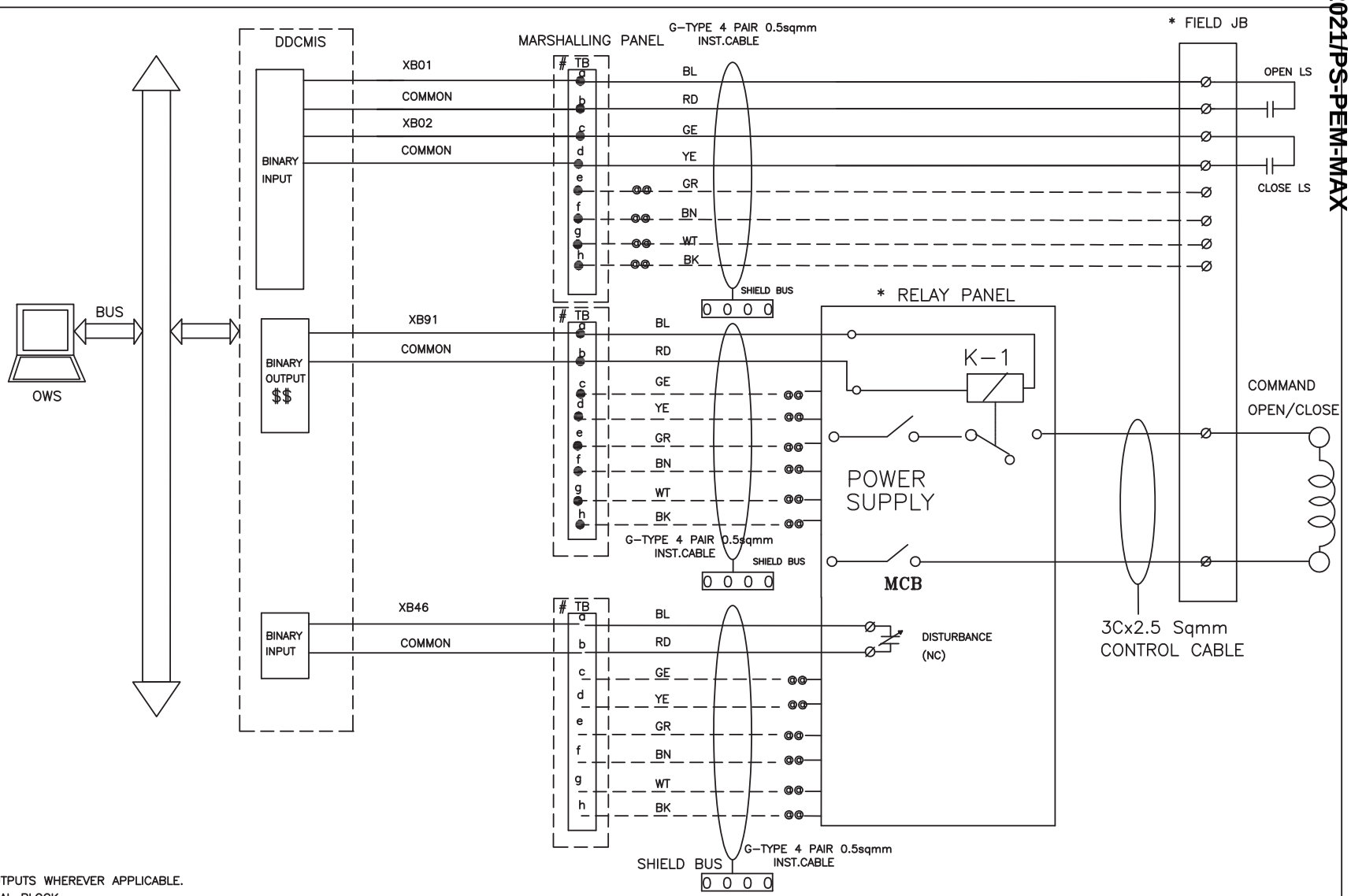
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE-I | DRG.NO. | 9585-001-405-PVI-B-152B |
| | DDCMIS INTERFACE WITH SOV/O/SOV/C(WITHOUT FEEDBACKS) | SHT | 11 OF 34 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



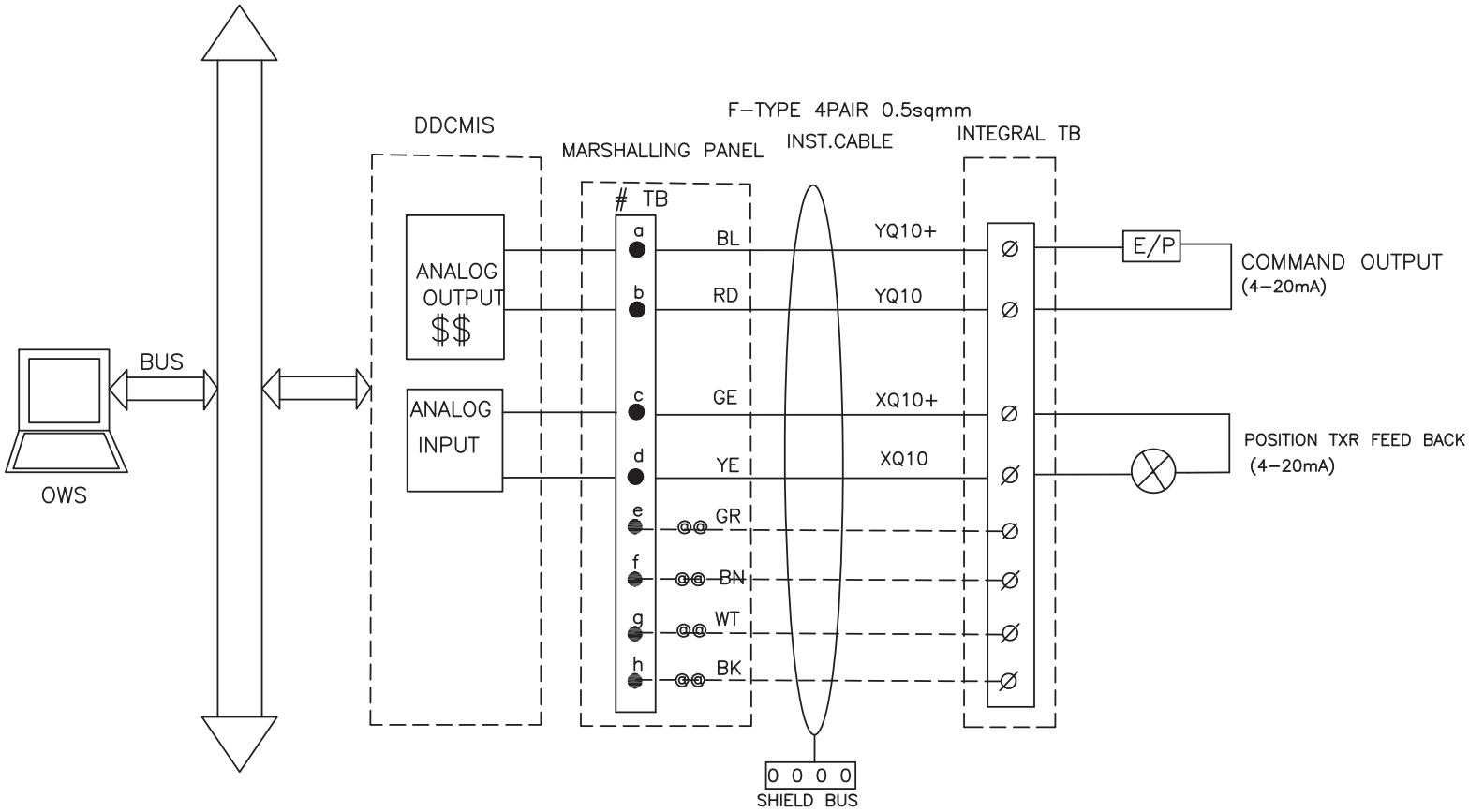
# DDCMIS INTERFACE WITH SOV/O/L(WITH FEED BACKS)




NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE-I | DRG.NO. | 9585-001-405-PVI-B-152B |
| | DDCMIS INTERFACE WITH SOV/O/L(WITH FEEDBACKS) | SHT | 12 OF 34 |

# INTERFACE FOR MODULATING DRIVES – CLCS



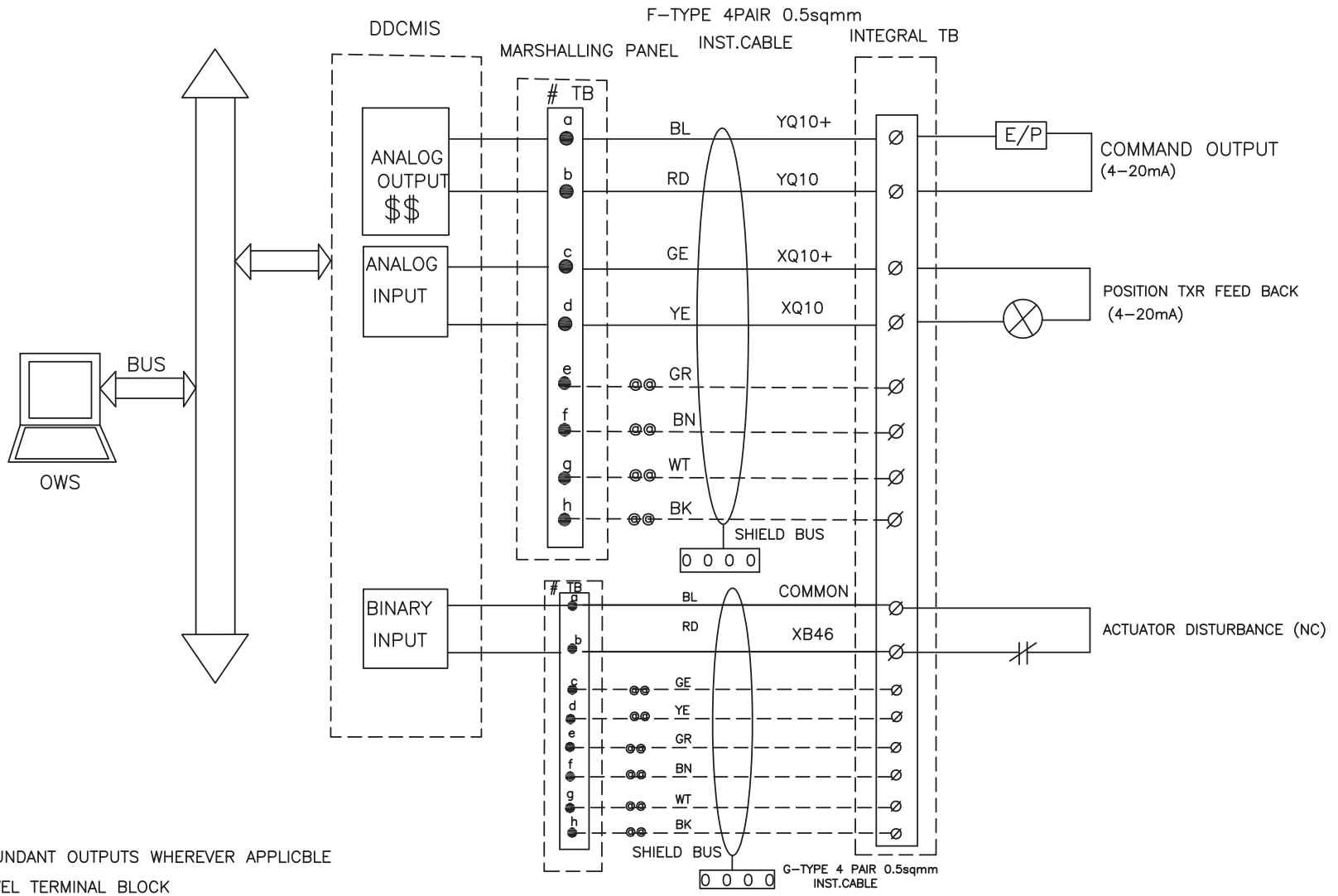

NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICBLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK

NOTE:–3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE–I | DRG.NO. | 9585–001–405–PVI–B–152B |
| | INTERFACE FOR MODULATING DRIVES – CLCS | SHT | 14 OF 34 |

# INTERFACE FOR MODULATING DRIVES – CLCS–M




NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICBLE

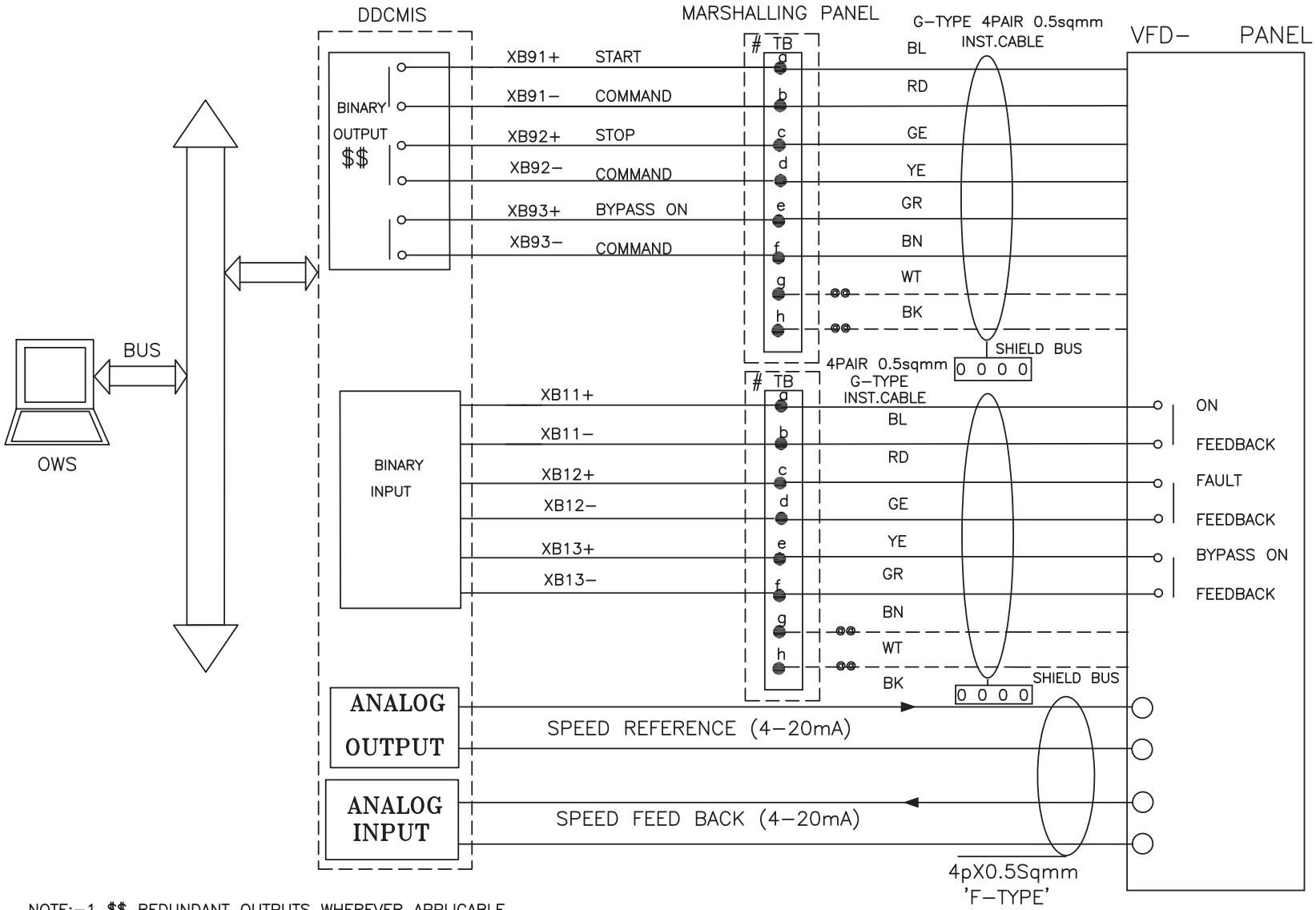
NOTE:–2 # 8 LEVEL TERMINAL BLOCK

NOTE:–3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE–I | DRG.NO. | 9585–001–405–PVI–B–152B |
| | INTERFACE FOR MODULATING DRIVES – CLCS–M | SHT | 15 OF 34 |

# DDCMIS INTERFACE WITH VFD



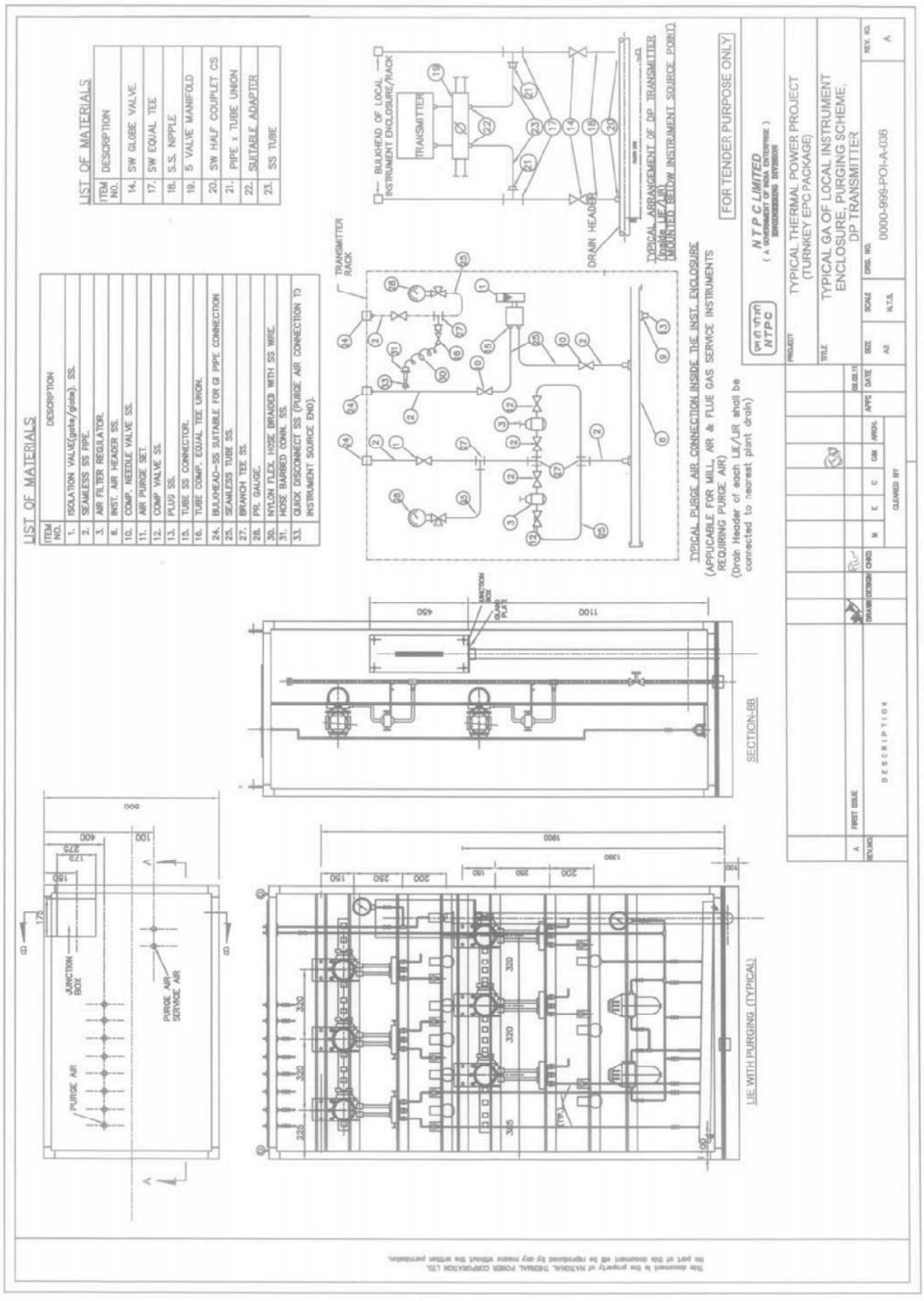

NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:–4 OTHER VFD SIGNALS WILL BE CONSIDERED AS PER IO LIST.

| | | | |
|---|---|---|---|
| BHEL | 3X800 MW NTPC PATRATU STPP PHASE–I | DRG.NO. | 9585–001–405–PVI–B–152B |
| | DDCMIS INTERFACE WITH VFD | SHT | 13 OF 34 |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

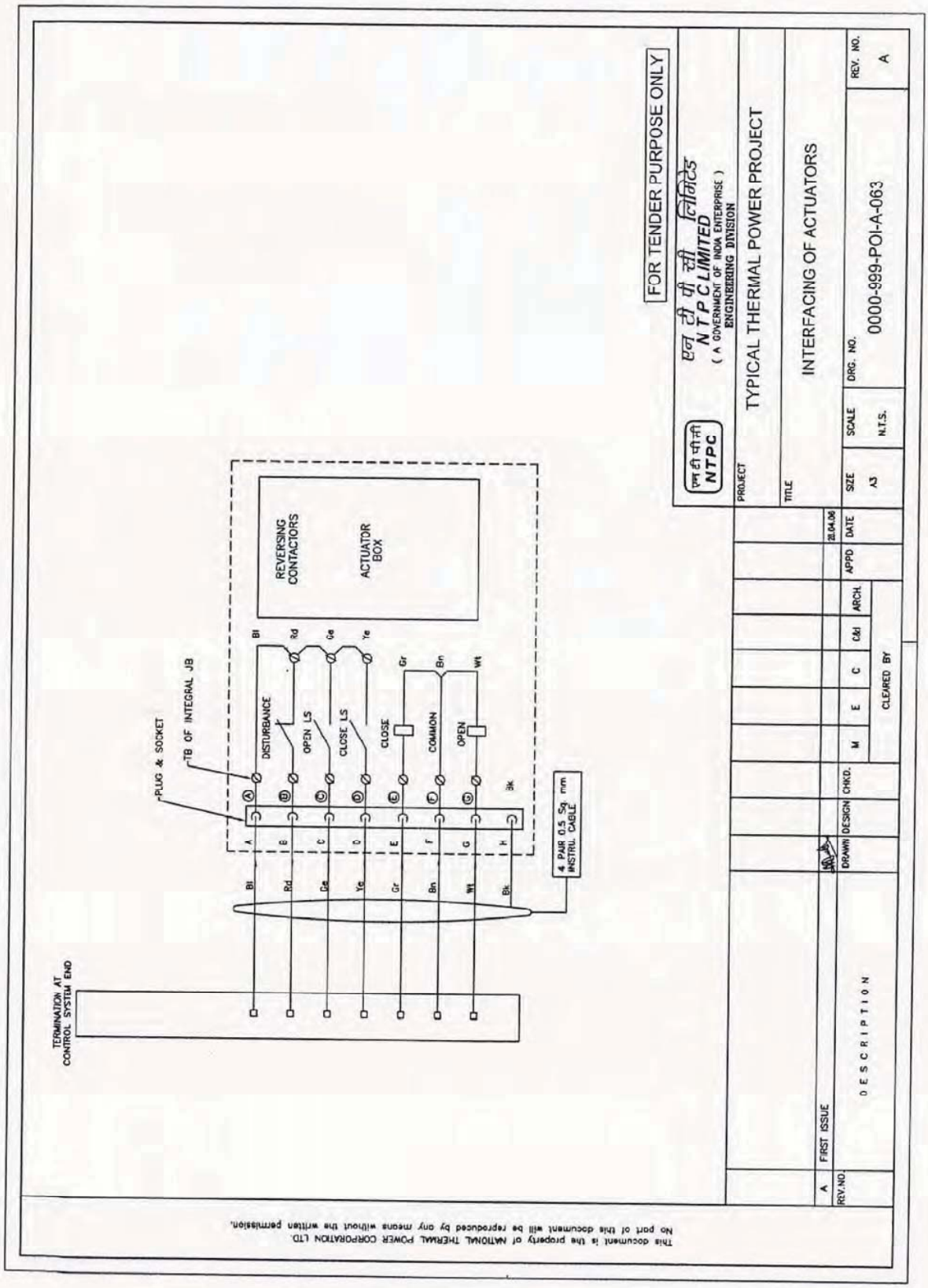
# DRIVE & INSTRUMENT INTERFACE DIAGRAM

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

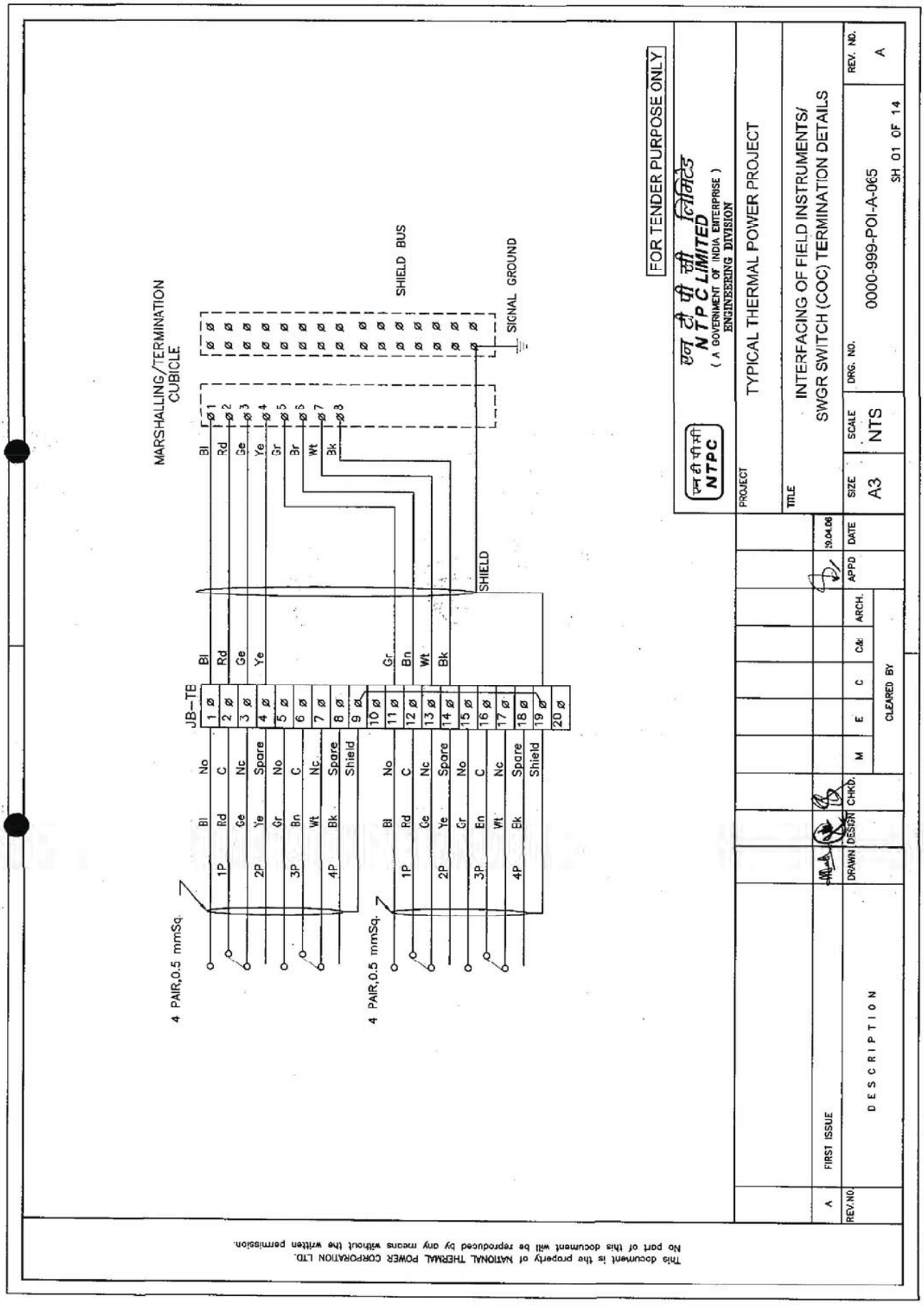



This document is the property of NATIONAL THERMAL POWER CORPORATION LTD. No part of this document will be reproduced by any means without the written permission.

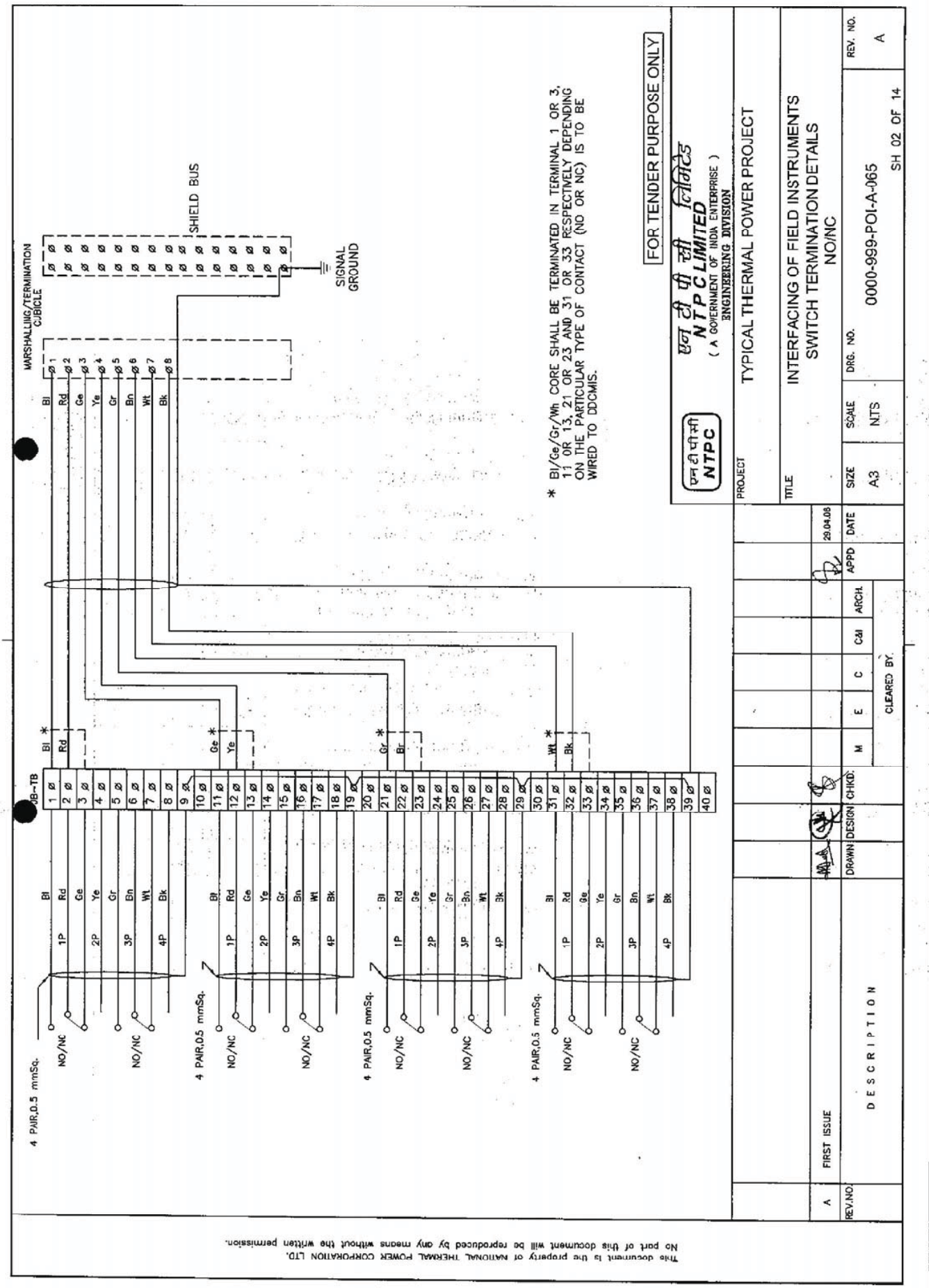
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



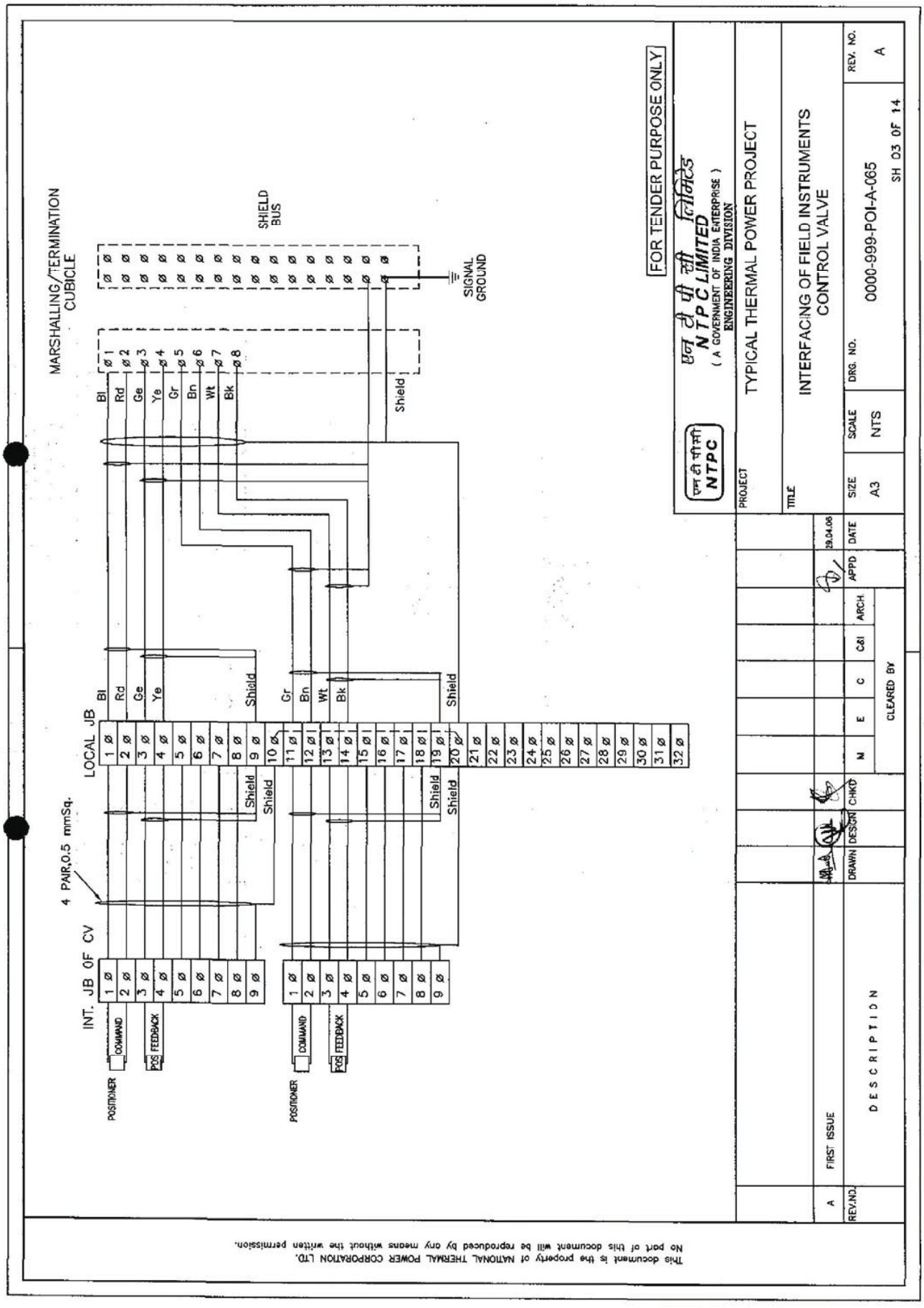
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



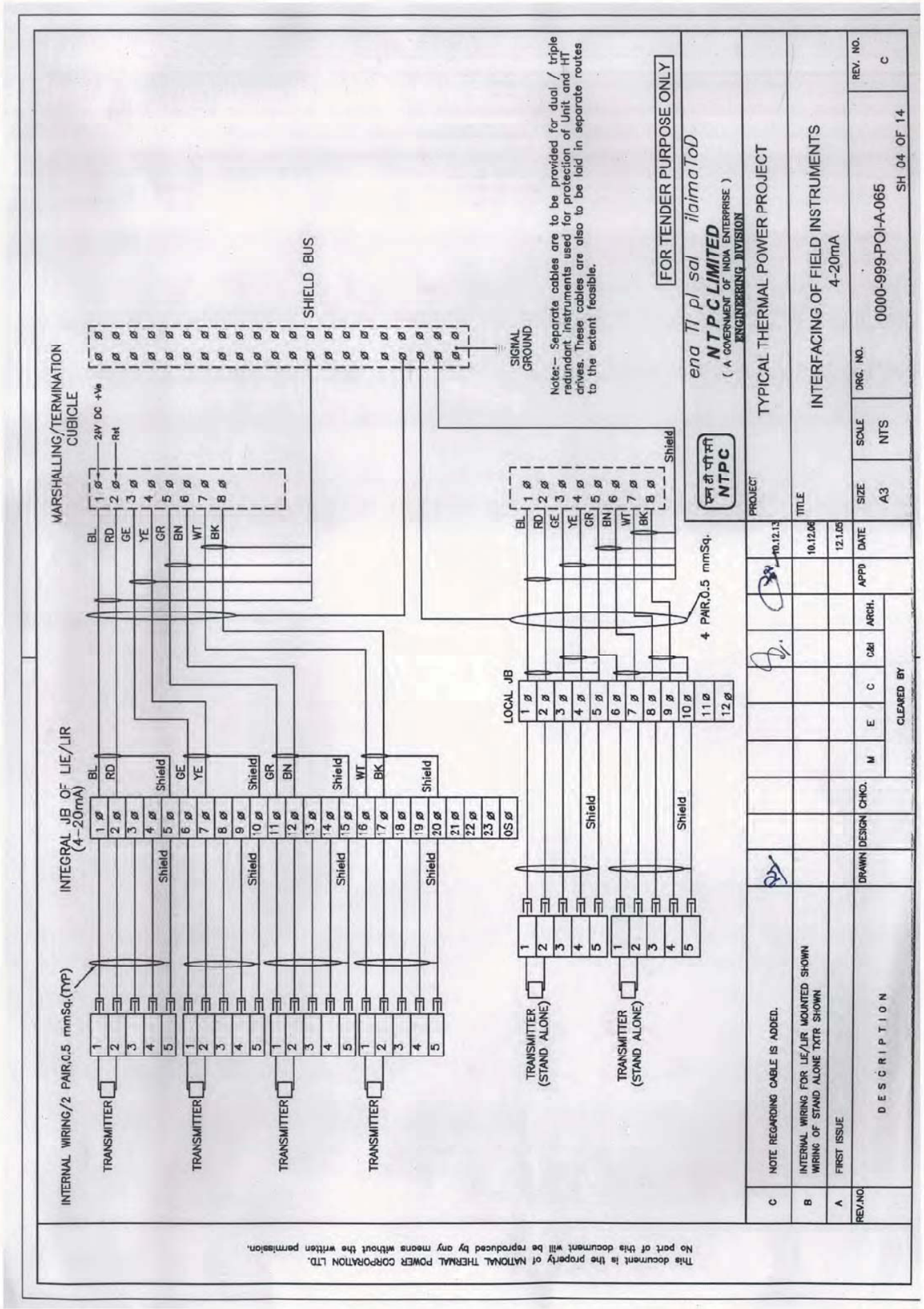
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

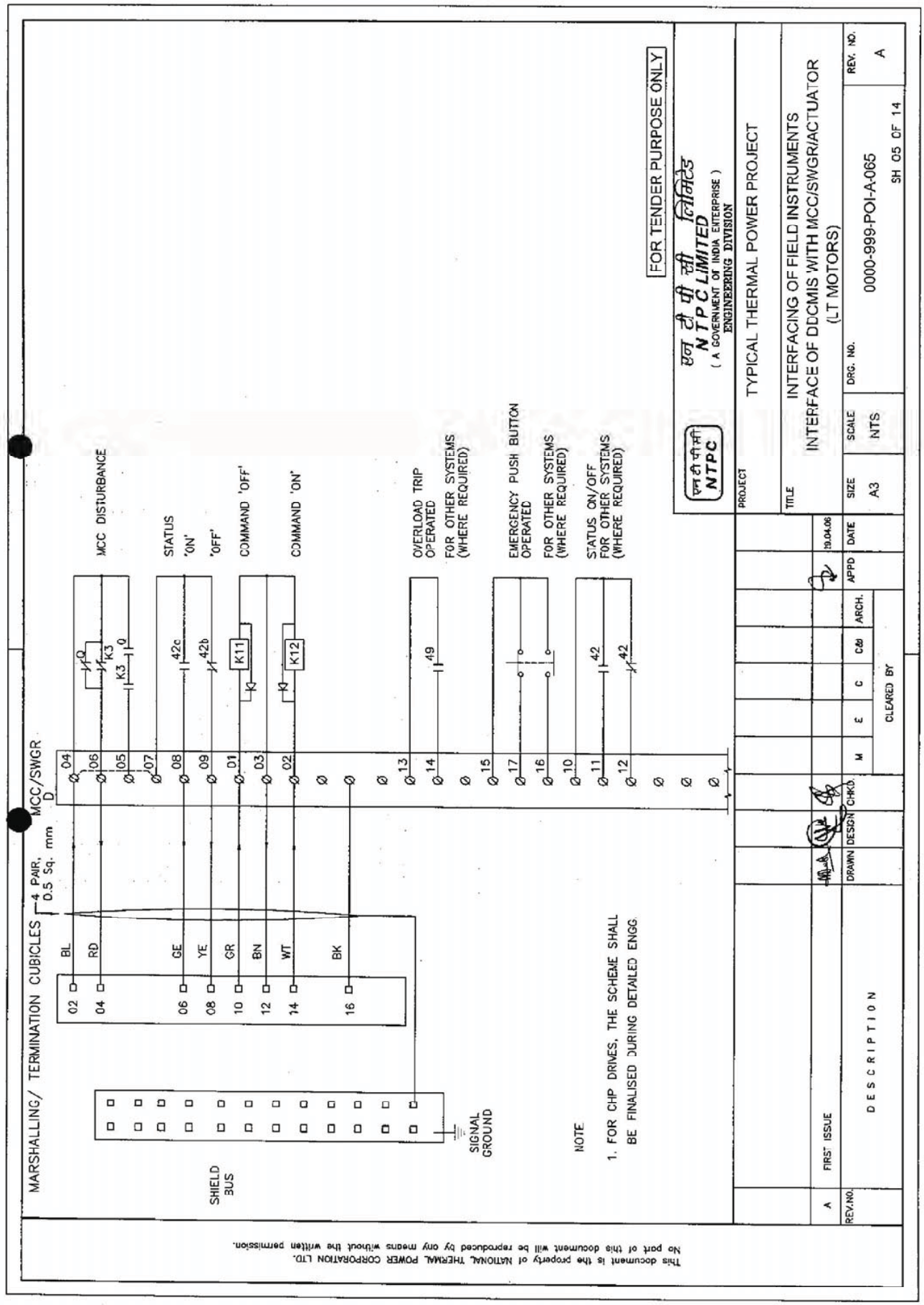


This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



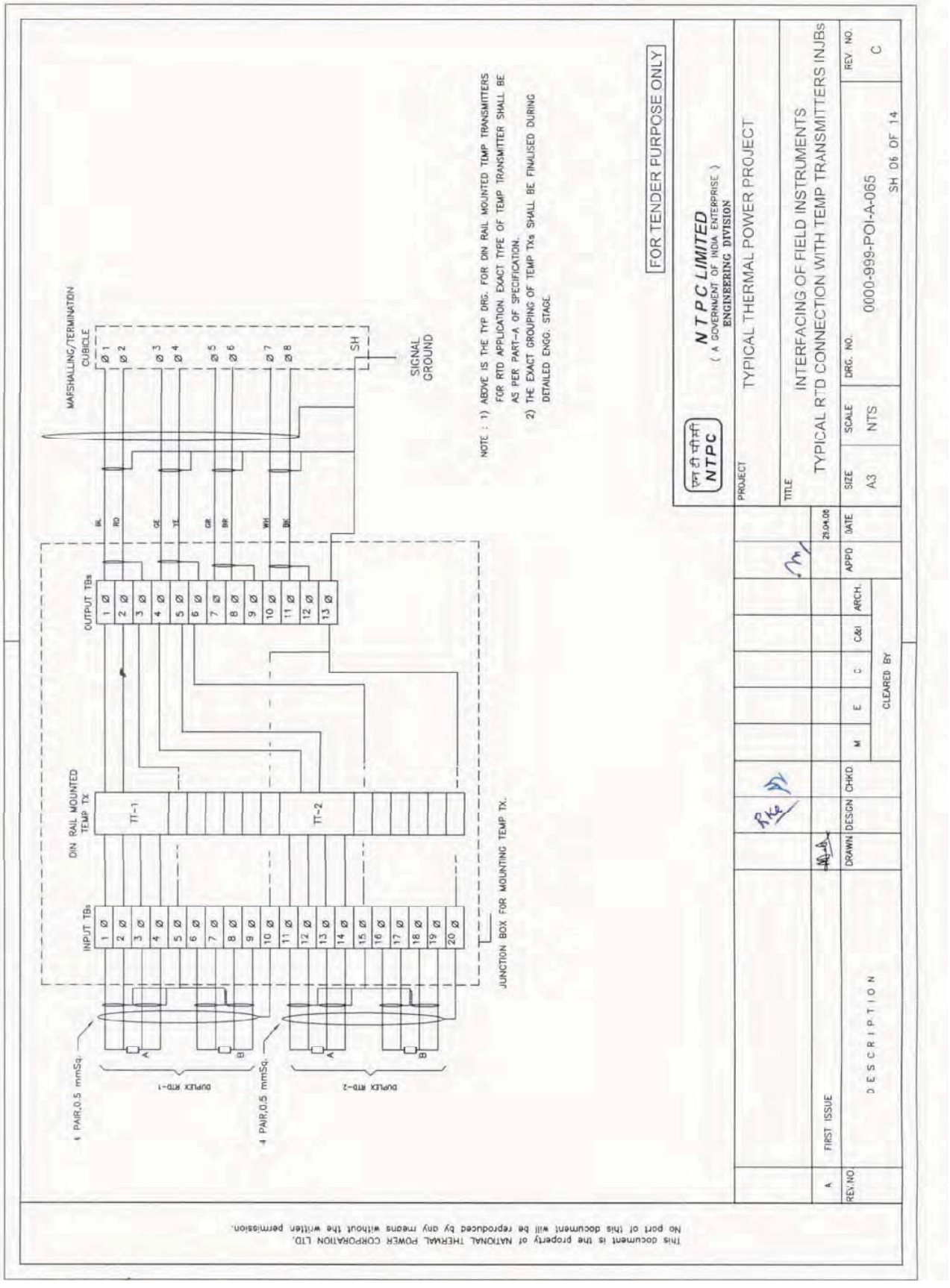
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



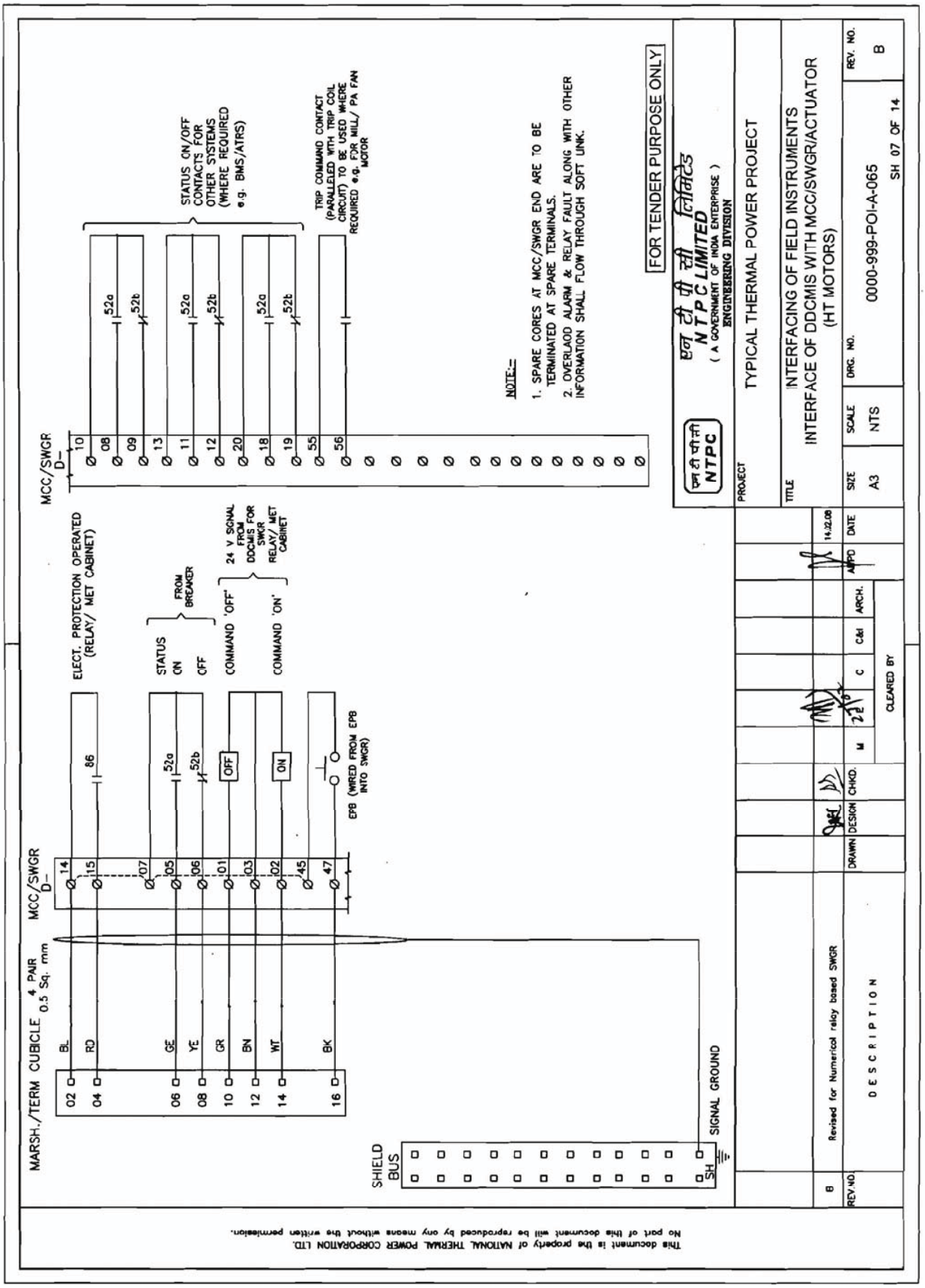



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

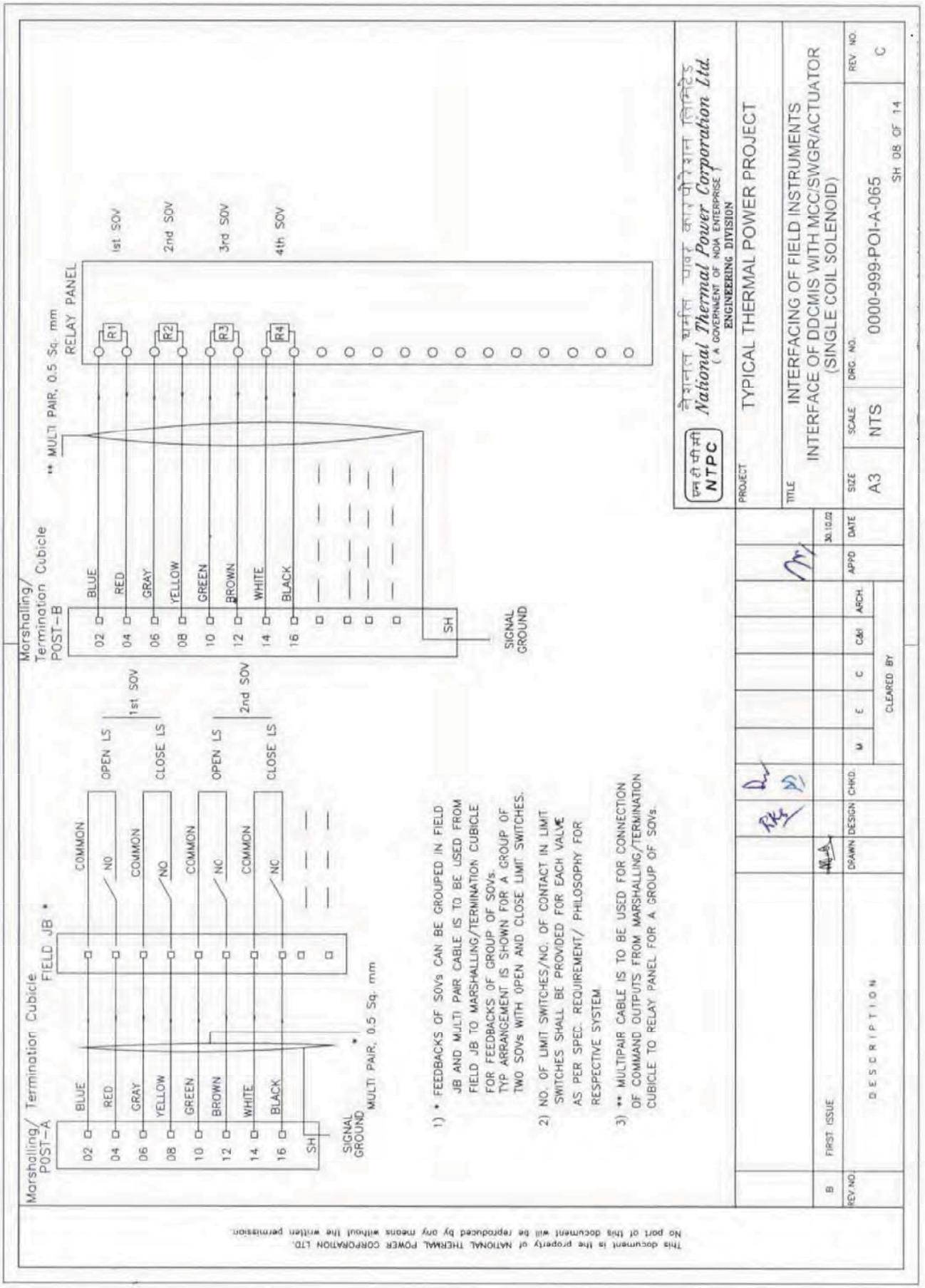
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



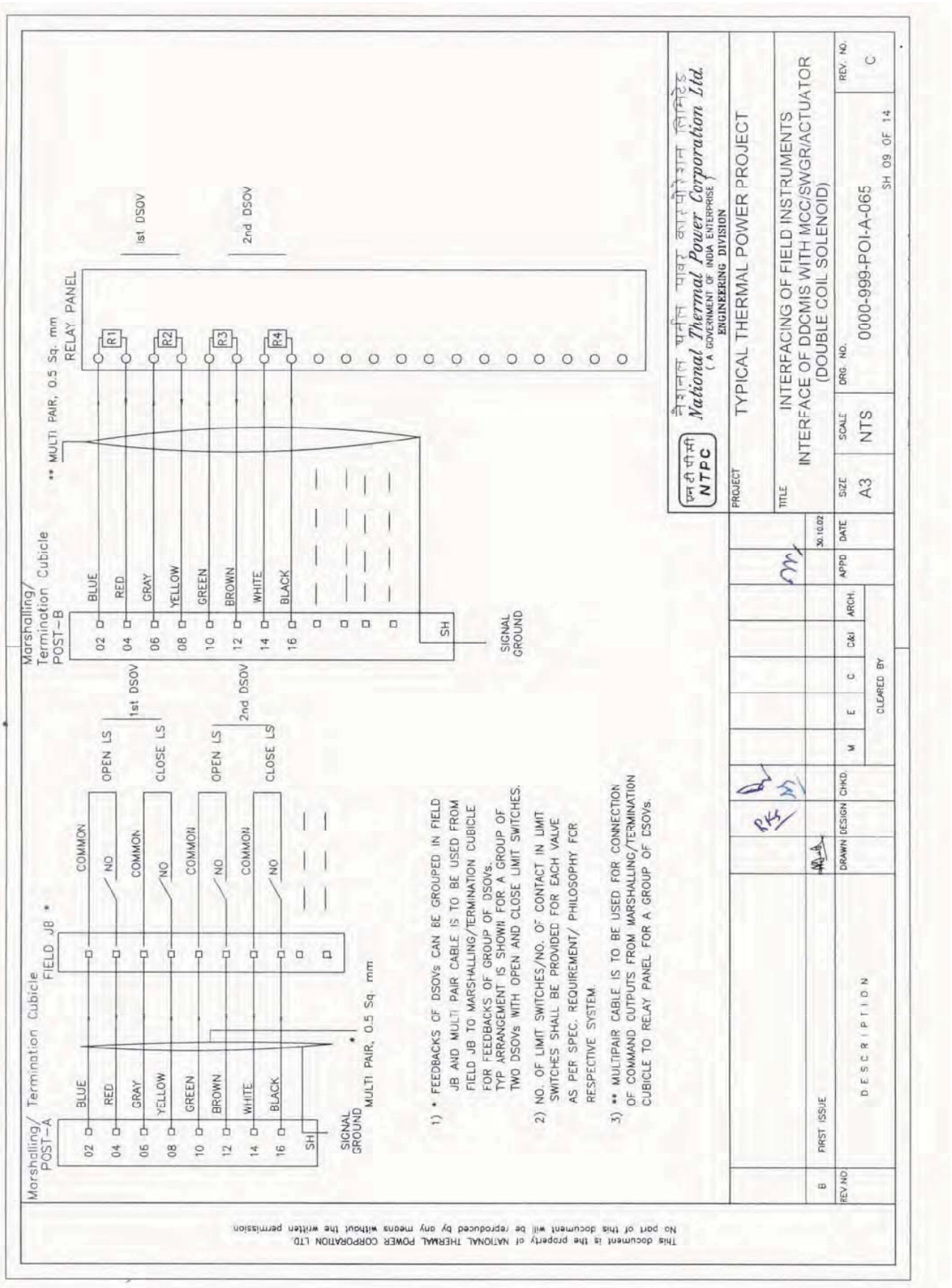
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



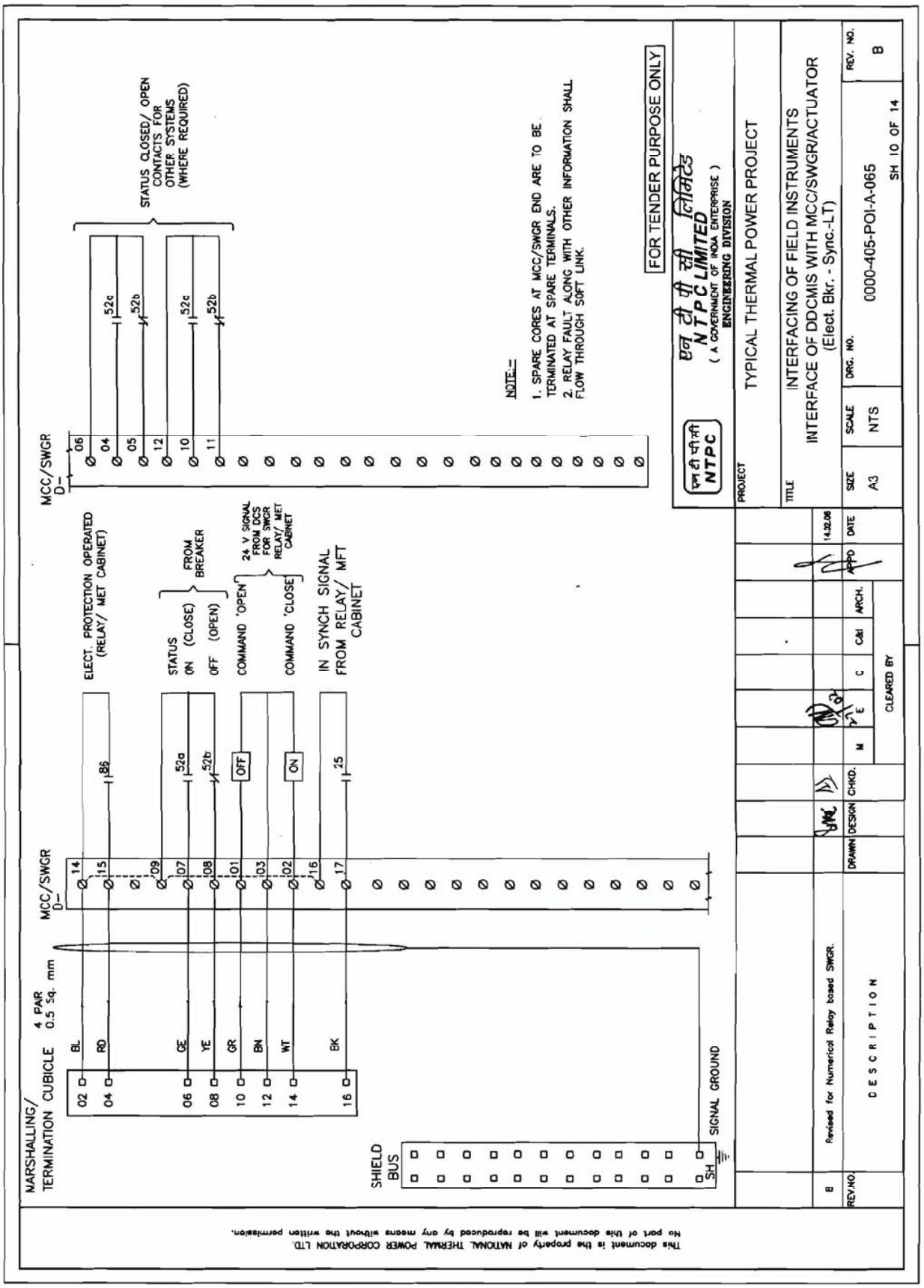
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



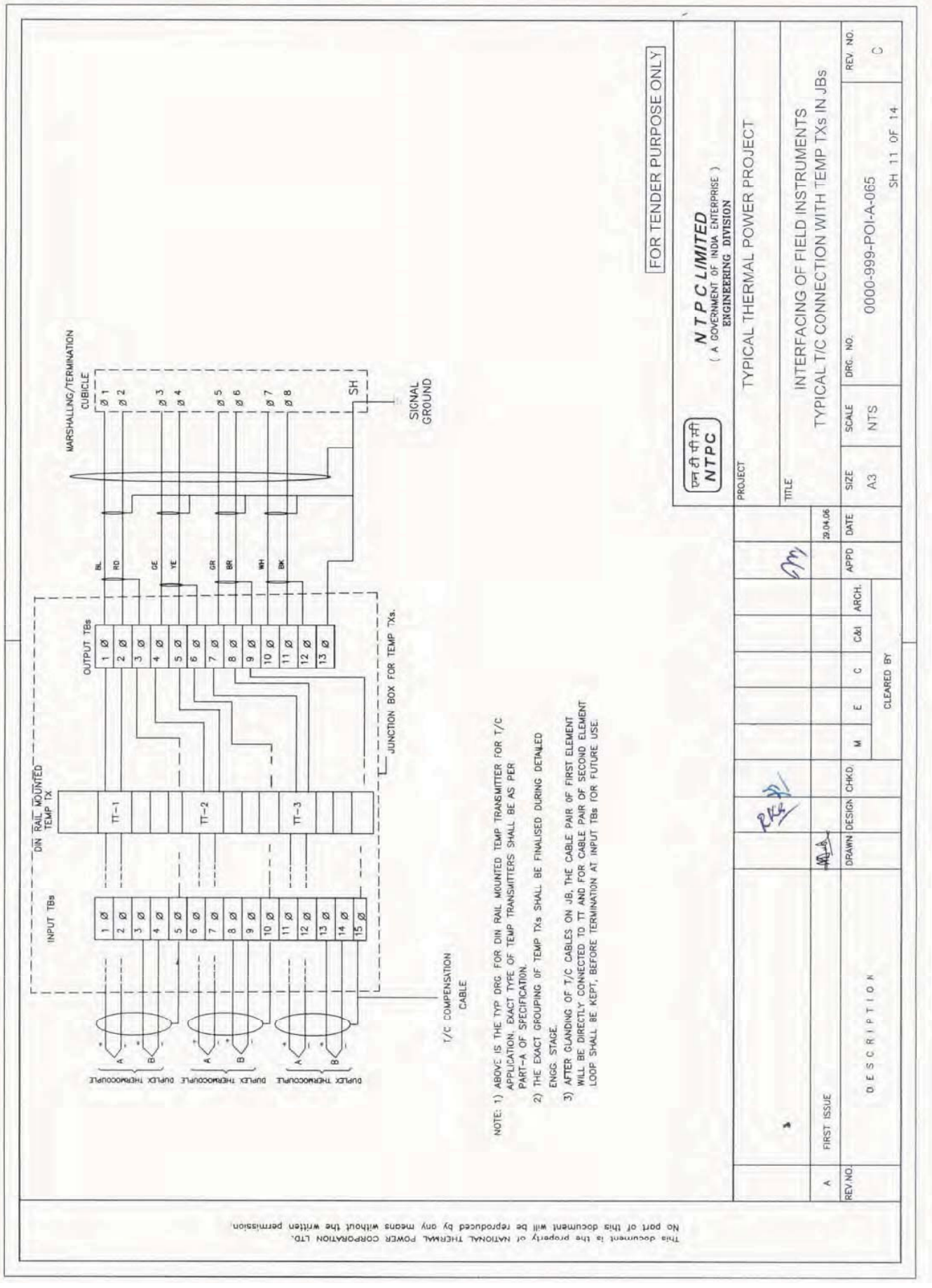
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



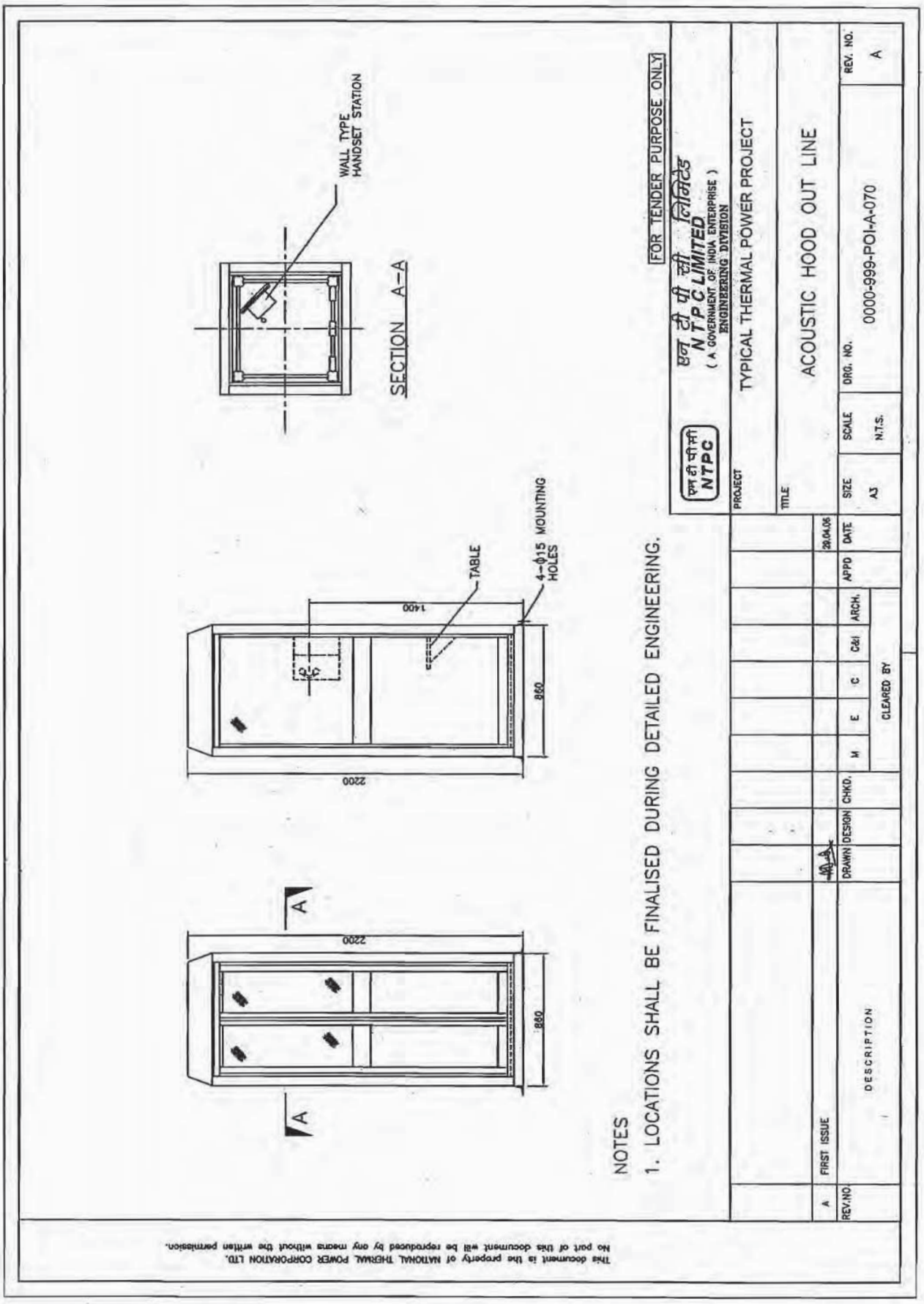
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



# INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**5.00.00** **INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY**

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

TABLE A: CABLE TERMINATION TO BE FOLLOWED

| Application | | Type Of Termination | | Type Of Cable |
|---|---|---|---|---|
| **FROM (A)** | **TO (B)** | **END A** | **END B** | |
| Valves/dampers drives (Integral Junction box) | Marshalling / Marshalling – cum Termination Cubicle / local group JB | Plug in connector | Post mount cage clamp type. | G |
| Transmitters, Process Actuated switches mounted in LIE/LIR | Integral Junction box of LIE/LIR | Plug in connector | Cage clamp (Rail mount) type. | F,G |
| RTD heads | Local junction box | Plug in connector | Cage clamp (Rail mount) type. | F |
| Thermocouple | Local junction box / CJC box (if applicable) | Plug in connector | Cage clamp (Rail mount) type. | A, B, C* |
| Other Field mounted Instrument | Local JB / Group JB | Plug in connector | Cage clamp (Rail mount) type. | F,G |
| RTD | Temperature transmitter | Plug in connector | Screwed, Cage clamp type | F |
| Thermocouple | Temperature transmitter | Plug in connector | Screwed, Cage clamp type | A, B, C* |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR | Group JB | Cage clamp (Rail mount) type. | Cage clamp (Rail mount) type. | F,G |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| Application | | Type Of Termination | | Type Of Cable |
|---|---|---|---|---|
| **FROM (A)** | **TO (B)** | **END A** | **END B** | |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR | Marshalling / Marshalling – cum Termination Cubicle | Cage clamp (Rail mount) type. | Cage clamp (Post mounted) type. | F,G |
| Marshalling cubicle/ Termination Cabinet | Electronic system cabinet | Cage clamp (Post mounted) type. | Plug-in connector / other system as per Mfr.'s Standard | Internal wiring |
| Marshalling/ Termination System Cabinets | UCD mounted equipments | Cage clamp (Post mounted) type. | Plug in connector / Cage clamp type (rail mounted). | F,G (with plug-in connector at one end) |
| DDCMIS/PLC cabinets | PC, Printers etc. | Plug in connector | Plug in connector | Mfr.'s Standard |

Notes

1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.

2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.

3 * For high temperature applications only.

4 . For connection between field/JB and DDCMIS marshalling cabinet

minimum 4 pair instrumentation cable shall be used.

5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.

6 For Cable type and cable termination scheme for the instruments/ equipment that are connected to Steam Turbine and Generator (STG) control system defined at Part A, sub section IIC, clause no. 2.03.01 (a) (ii) above and hydrogen generation plant auxiliaries system, Contractor's standard and proven practice is also acceptable. However, for termination of instrumentation cable at marshalling cabinets/DCS panel end, cage-clamp termination shall be offered. For power and control cable termination, Contractor's standard and proven practice would be acceptable

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **6.00.00** | **TERMINAL BLOCKS** |
| 6.01.00 | All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval. |
| 6.02.00 | All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc. |
| 6.03.00 | The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks. |
| 6.04.00 | For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065. |
| 6.05.00 | The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls. |
| **7.00.00** | **INTERNAL PANELS/ SYSTEM CABINETS WIRING** |
| 7.01.00 | Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815. |
| 7.02.00 | All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule. |
| 7.03.00 | All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points. |
| 7.04.00 | All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables. |
| 7.05.00 | All the special tools as may be required for solder less connections shall be provided by Bidder. |
| 7.06.00 | Wire sizes to be utilised for internal wiring.<br>(i) Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system. — 0.5 Sq.mm.<br>(ii) Power supply and internal illumination. — 2.5Sq.mm. minimum (shall be as per load requirement.) |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**8.00.00** **INSTRUMENTATION CABLE INSTALLATION AND ROUTING**

8.01.00 All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.

8.02.00 Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

| | | |
|---|---|---|
| From 11 kV/6.6 kV/3.3 kV tray system | - | 914 mm |
| From 415V tray system | - | 610 mm |
| From control cable tray system | - | 305 mm |

8.03.00 Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.

8.04.00 Not in use

8.05.00 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

**9.00.00** **CABLE LAYING AND ACCESSORIES**

9.01.00 CABLE LAYING

1 Cables shall be laid strictly in line with cable schedule.

2 Identification tags for cables.

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

3 Cable tray numbering and marking.

To be provided at every 10m and at each end of cable way & branch connection.

4 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.

5 Buried cable protection

With concrete slabs; Route markers at every 20 Meters along the route & at every bend.

6 Road Crossings

Cables to pass through buried high density PE pipes encased in PCC. At least 300



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | mm clearance shall be provided between<br><br>- HT power & LT power cables,<br><br>- LT power & LT control/instrumentation cables,<br><br>Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.<br><br>7 Segregation (physical isolation to prevent fire jumping)<br><br>a All cable associated with the unit shall be segregated from cables of other Units.<br><br>b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.<br><br>8 Cable clamping<br><br>All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.<br><br>9 Optical fiber cables ( OFCs) :<br><br>Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure<br><br>**Inside Building Area – to be laid on separate cable sub-trays**<br><br>While buried- in separate burried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor;<br><br>While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;<br><br>While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.<br><br>10 **Laying of Network Cable (UTP/STP) :**<br><br>**Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.**<br><br>**Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.** |
| 9.02.00 | Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis. |
| 9.03.00 | Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

9.04.00 The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.

9.05.00 The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.

**10.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES**

| | | |
|---|---|---|
| (i) | No. of ways | 12/24/36/48/64/72/96/128 with 20% spares terminals. |
| (ii) | Material and Thickness | 4mm thick Fiberglass Reinforced Polyester (FRP). |
| (iii) | Type | Screwed at all four corners for door. Door gasket shall be of synthetic rubber. |
| (iv) | Mounting clamps and accessories | Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply. |
| (v) | Type of terminal blocks | Rail mounted cage-clamp type suitable for conductor size upto 2.5 $mm^2$. A M6 earthing stud shall be provided. |
| (vi) | Protection Class | IP: 55 minimum for indoor & IP-65 minimum for outdoor applications. |
| (vii) | Grounding | To be provided. |
| (viii) | Color | RAL 7035 |

**11.00.00 CONDUITS**

11.01.00 Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated galvanized steel with , water leak, fire and rust proof protected *for the areas of* Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's .

*And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.* The temperature rating of flexible conduit shall be suitable for actual application.

11.02.00 All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.

11.03.00 Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | with NEC requirements for the area classification. |
| 11.04.00 | Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits. |
| 11.05.00 | Conduits shall be securely fastened to all boxes and cabinets. |
| **12.00.00** | **CABLE SUB-TRAY & SUPPORT** |
| 12.01.00 | The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route). |
| 12.02.00 | The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# QUALITY ASSURANCE-INSTRUMENTS

**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**

| TESTS / ITEMS | Dimensions (R) | Make, Model, Type, Rating (R) | Process / Electrical connection (R) | Calibration (R) | Test as per standard(R) | Insulation Resistance (R) | IBR Certification (if applicable )(R) | Hydro Test(R) | Material Test certificate ® |
|---|---|---|---|---|---|---|---|---|---|
| 1. PR Gauge (IS-3624) | Y | Y | Y | Y | Y | | | | |
| 2. Temp. Gauge (BS-5235) | Y | Y | Y | Y | Y | | | | |
| 3. Pr./D.P.Switch(BS-6134) | Y | Y | Y | Y | Y | Y | | | |
| 4. Electronic Transmitter(IEC-770) | Y | Y | Y | Y | Y | Y | | | |
| 5. Temp. Switch | Y | Y | Y | Y | Y | Y | | | |
| 6. Recorder(IS-9319/ANSI C-39.4) | Y | Y | Y | Y | Y | Y | | | |
| 7. Vertical indicators | Y | Y | Y | Y | | Y | | | |
| 8. Digital Indicators | Y | Y | Y | Y | | Y | | | |
| 9. Integrators | Y | Y | Y | Y | | | | | |
| 10. Electrical Metering Instrument (IS-1248) | Y | Y | Y | Y | Y | Y | | | |
| 11. Transducer (IEC-688) | Y | Y | Y | Y | Y | Y | | | |
| 12. Thermocouples (ANSI-MC-96.1) | Y | Y | Y | Y | Y | Y | | | |
| 13. RTD(IEC-751) | Y | Y | Y | Y | Y | Y | | | |
| 14. Thermowell | Y | | Y | | | | Y | Y | Y |

R-Routine Test A- Acceptance Test Y – Test applicable

:

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| TESTS / ITEMS | Dimensions (R) | Make, Model, Type, Rating (R) | Process / Electrical connection (R) | Calibration (R) | Requirement as per standard (R) | WPS approval (A) | Non-destructive testing (R) | Calculation for accuracy (R) | Insulation Resistance (R) | IBR Certification as applicable (R) | Hydro test (R) | Material test certificate (A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15. Cold junction compensation box | Y | Y | Y | Y | | | | | Y | | | |
| 16. Orifice plate(BS-1042) | Y | Y | Y | Y * | Y | Y ** | Y ** | | | Y | Y ** | Y |
| 17. Flow nozzle(BS-1042) | Y | Y | Y | Y * | Y | Y | Y | | | Y | Y | Y |
| 18. Impact head type element | Y | Y | Y | | | | | Y | | | | Y |
| 19. Level transmitter/float type switch | Y | Y | Y | Y | | | | | Y | Y | Y | Y |
| 20. Flue Gas analyser | Y | Y | Y | Y | | | | | | | | |
| 21. Dust emission monitors | Y | Y | Y | Y | | | | | | | | |
| *Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated. | | | | | | | | | | | | |
| ** If applicable | | | | | | | | | | | | |

R-Routine Test A- Acceptance Test Y – Test applicable

**Note:** 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance. Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

| Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING | RPM ® | No Load Current ® | IR & HV Test® | Mounting Dimension® | All routine Test as per Standard & Specification® | Correct Phase Sequence® | Operation & Setting of limit Switch/Torque Switch® | Stall Torque/Current (A) | Hand Wheel operation/ Auto de clutch function (A) | Function of Aux. like Potentiometer, space heater, position indicator ® | EPT output ® | Grease leakage ® | Local/ Remote ( Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)** | | | | | | | | | | | | | |
| Motor | Y | Y | Y | Y | Y | | | | | | | | |
| Final Testing | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure finalized during QP finalization

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

® - Routine Test (A) - Acceptance Test Y - Test applicable

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB-SECTION–E-58

# VFD MODULES

.

| VFD MODULE SQE_28 | | | | |
|---|---|---|---|---|
| **ATTRIBUTES / CHARACTERISTICS** / **ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY** | Visual & Dimensional checks | Make / Type / Rating etc. | Final Inspection as ISS / IEC | Remarks |
| HT Breaker (IEC 56) | Y | Y | Y | |
| DC Reactor | Y | Y | | For details refer table for DC Reactor |
| Transformer | Y | Y | | For details refer table for Transformer |
| Motor | Y | Y | | For details refer separate table for Motor |
| VFD Panel | Y | Y | | For details refer table for VFD |

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

2) Make of all major Bought Out Items will be subject to NTPC approval.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## DC REACTOR

| ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY | Visual | Dimensional | Mech. & Chem. Property | Electrical Characteristics | Pretreatment by Seven Tank | Painting by Stove Enameling | Final Inspection as per IS-2026 | Welding/NDT |
|---|---|---|---|---|---|---|---|---|
| Winding Material (Aluminium) | Y | Y | Y | Y | | | | |
| Insulation Material | Y | Y | | Y | | | | |
| Sheet Steel | Y | Y | Y | | | | | |
| Winding | Y | Y | | Y | | | | |
| Fabrication of Enclosures | Y | Y | | | Y | Y | | Y |
| Assembly | Y | Y | | | | | | |
| Routine Tests | Y | Y | | | | | Y | |

Note :
1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice & procedure along with relevant supporting documents during QP finalisation for all items.
2) All major Bought Out Items will be subject to NTPC approval.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**QUALITY ASSURANCE**

**TRANSFORMER (OIL FILLED)**

| Attributes / Characteristics / Items/Components Sub Systems | Visual & Dimensional Checks | Mechanical properties | Electrical strength | Thermal properties | Chemical Composition | Compatibility with oil | NDT / DPT / MPI / UT | Ageing Test. | Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test | Make / Type / Rating / Model / TC / General Physical Inspection. | WPS & PQR | Routine Test as per relevant test | Routine Test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tank, H.V. & L.V. Cable Box / Flange throat | Y | Y | | | | | Y | | | | | | |
| Conservator / Radiator / Cooler / Pipes | Y | Y | | | | | Y | | | | | | |
| Copper Conductor (IS:191) | Y | Y | Y | | Y | | | | | | | | |
| Insulating Material | Y | Y | Y | Y | Y | Y | | | | | | | |
| CRGO Lamination & Built Core | Y | Y | Y | | Y | Y | | | | | | | |
| Bushing / Insulator ( IS:2544 / 5621) | Y | Y | | | | | | | | Y | | Y | |
| Gasket | Y | | | | Y | Y | | Y | | | | Y | |
| Transformer Oil ( IS:335 / IEC296) | | | | | | | | | | | | Y | |
| Off-Circuit Tap Changer | Y | | | | | | | | | Y | | | |
| Core Coil Assembly & Pre-tanking | Y | | | | | | | | Y | | | | |
| Marshalling Box | Y | Y | | | | | Y | | | | | Y | |
| WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve, | Y | | | | | | | | | Y | | | |
| Welding (ASME Sect-IX) | Y | | | | | | | | | | Y | | |
| Complete Transformer (IS:2026/ IEC-60076) | Y | | | | | | | | | | | | Y |

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

**DRY TYPE TRANSFORMER**

| Attributes / Characteristics / Items/Components Sub Systems | Visual & Dimensional check | Mechanical properties | Electrical strength | Thermal Properties | Chemical Properties | NDT / DP / MPI | Voltage Ratio, Vector Group & Polarity | Make / Type / Rating / Model /TC / General Physical Inspection | WPS & PQR | Routine Test as per relevant | Measurement of capacitance & tan delta between winding | Routine Test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enclosure door, H.V. & L.V. Cable Box / Flange Throat | Y | Y | | | | | | Y | | | | |
| Copper Conductor | Y | Y | Y | | Y | | | | | | | |
| Insulating Material | Y | | | Y | Y | | | | | | | |
| CRGO Lamination & Built Core | Y | | | | | | | | | | | |
| Bushing /Insulator ( IS:2544 / 5621) | Y | | | | | | | Y | | Y | | |
| Gasket | Y | | | | | | | Y | | Y | | |
| Off-Circuit Tap Changer | Y | | | | | | | Y | | | | |
| Core Coil Assembly | Y | | | | | | Y | | | | | |
| Marshalling Box | Y | | | | | | | | | Y | | |
| WTI, Thermister, Terminal Connector | Y | | | | | | | Y | | | | |
| Welding | | | | | | | | | Y | | | |
| Complete Transformer (IS:11171 / IEC 60076) | Y | | | | | | | | | | Y | Y |

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.
2) All major Bought out Items will be subject to NTPC approval.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

**VFD PANEL**

| Attributes Characteristics / Item Components Sub System Assembly | Electrical Properties | Mechanical Properties | Chemical Properties | Dimensions / Finish | Type/ Rating/Functional check | HV/IR | Routine test as per relevant std. | Constructional Features | IS:6005 ,Seven tank process | Paint finish/ shade/thickness | Mountings / BOM/ Make, Completeness | Interlock Functional & Operation Testing / Simulation check | Degree of Protection Test | Final testing as per Relevant IS/IEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sheet Steel (IS-513) | | Y | Y | Y | | | | | | | | | | |
| Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987) | Y | Y | Y | Y | | | | | | | | | | |
| Support Insulator (BS-2782/IEC-660/IS-10912) | Y | Y | Y | Y | | | | | | | | | | |
| Control / Selector Switch(IS-6875) | | | | | Y | Y | Y | | | | | | | |
| Contactor/ MCB(IS-13947) | | | | | Y | Y | Y | | | | | | | |
| O/L Protection relays(IS-3231) | | | | | Y | | Y | | | | | | | |
| C.T /V.T/ Indicating Meter(IS-2705/3156/1248) | | | | | Y | Y | Y | | | | | | | |
| Fuse/ Fuse carrier(IS-13703) | | | | | Y | Y | Y | | | | | | | |
| Terminals/lugs/pvc wires(IS-13947//IS-694) | Y | | | Y | Y | Y | Y | | | | | | | |
| Timers(IS-3231) | | | | | Y | Y | Y | | | | | | | |
| Push Button/ Lamp/ (IS-6875) | | | | | Y | Y | Y | | | | | | | |
| Control Transformer (IS-12021) | | | | | Y | Y | Y | | | | | | | |
| Mimic, Annunciater | | | | | Y | | Y | | | | | | | |
| GASKET(IS-11149) | | Y | Y | Y | Y | | Y | | | | | | | |
| Fabrication | | | | | | | | Y | | | | | | |
| Pretreatment & Painting | | | | | | | | | Y | Y | | | | |
| VFD panel | | | | | | | | | | Y | Y | Y | Y | Y |

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

## STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

### CHECK LIST FOR SOLENOID VALVES

| Sl. No. | Test / Checks | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | M | C | B | |
| 1 | CHECK FOR | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS | P | W | V | |
| | TYPE | | | | | | |
| | MAKE | | | | | | |
| | MODEL No. | | | | | | |
| 2 | MATERIAL (BODY. PLUNGER/TRIM) | | | P | W | V | |
| 3 | PORT SIZE | | | P | W | V | |
| 4 | CABLE CONNECTION SIZE | | | P | W | V | |
| 5 | ENCLOSURE CLASS | | | P | W | V | TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR |
| 6 | No. OF COILS & INSULATION CLASS | | | P | W | V | TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR |
| 7 | POWER SUPPLY CHECK | | | P | W | V | |
| 8 | IR / HV TEST | | | P | W | V | |
| 9 | FUCTIONAL TEST | | | P | W | V | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Legend :**

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

**Note :**

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

PEM :: C&I

# STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION C
ISSUE NO. 2 REV. NO. 00 DATE: 25.05.2016
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 $ P | Agency $ W | Agency $ V | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.0** | **INCOMING MATERIAL** | | | | | | | | | | | |
| 1.1 | Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage. | 1. Physical, Chemical properties | MA | Physical, Chemical tests | One/ Heat(HT Batch) | Approved drg. / data sheet / | Approved drg. / data sheet / | Test Certificate | 3 | --- | 2,1 | TC for body/bonnet from foundry only |
| | | 2. Heat Treatment | MA | Review of H.T. Chart | Each H.T. | Approved drg. / data sheet / | Approved drg. / data sheet / | Test Certificate | 3/2 | 2 | 1 | 1.IBR Certification (if applicable) to be verified by BHEL. 2.Applicable for body /bonnet only |
| | | 3. Internal quality of castings | MA | RT for Body & UT for Bonnet | 100% | ASME B 16.34 | ASME B 16.34 | Test Report / FILM | 3/2 | 2 | 1 | Applicable for body and bonnet for rating ANSI 900 and above. |
| | | 4. Surface Quality | MA | 1. Visual | 100% | MSS-SP-55 | MSS-SP-55 | Test Certificate | 3/2 | --- | 2 | |
| | | | | 2. MT/PT | 100% | ASME B 16.34 | ASME B 16.34 | Test Certificate | 3 | 2 | 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. |
| 1.2 | Diaphragm | 1. Surface Quality | MA | Visual | 100% | Mfr. standard | Mfr. standard | Test Certificate | 3/2 | --- | 2 | |

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 C
ISSUE NO. 2 REV. NO. 00 DATE: 25.05.2016
SHEET 2 OF 6

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ P | Agency $ W | Agency $ V | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2. Hardness | MA | Measurement | 100% | Mfr. standard | Mfr. standard | Test Certificate | 3/2 | --- | 2 | |
| | | 3. Endurance / Life cycle | MA | Cyclic test 10,000 cycles | One / Type | 10,000 cycles/ Mfr. standard. | No damage | Test Certificate | 3/2 | --- | 2,1 | |
| 1.3 | Spring | 1. Composition | MA | Chemical-Analysis | One sample/ Heat | Material spec. / Mfr. standard | Material spec. / Mfr. standard | Test Certificate | 3 | --- | 2 | |
| | | 2. Mech. Properties | MA | Mech. Test | One sample/ Heat | Material spec. / Mfr. standard | Material spec. / Mfr. standard | Test Certificate | 3 | --- | 2 | |
| | | 3. Performance | MA | 1. Stiffness ratio | 100% | Material spec. / Mfr. standard | Material spec. / Mfr. standard | Test Certificate | 3 | --- | 2 | |
| | | | | 2. Scragging | 100% | Material spec. / Mfr. standard | Material spec. / Mfr. standard | Test Certificate | 3 | --- | 2 | |
| | | | | 3. Cyclic test (Endurance) | One / type | 10,000 cycles | Material spec. / Mfr. standard | Test Certificate | 3 | --- | 2,1 | |
| | | | | 4. Dimension (Measurement) | One sample/ Lot | Mfr. standard | Mfr. standard | Record | 3 | --- | 2 | |
| 1.4 | Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)] | 1. Routine Test | MA | HV, IR, Continuity function | 100% | Relevant Standards | Relevant Standards | Test Certificate | 3 | --- | 2 | |
| | | 2. Degree of protection | MA | IP/NEMA Tests | One sample / type | Approved Data sheet | Approved Data sheet | Test Certificate | 3 | --- | 2,1 | |

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

PEM :: C&I

# STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION C
ISSUE NO. 2 REV. NO. 00 DATE: 25.05.2016
SHEET 3 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 | |
| 1.5 | Pressure Gauges | 1. Performance | MA | Review of calibration certificates | 100% | Mfr. Standard | Mfr. Standard | Test Certificate | 3 | --- | 2 | |
| | | 2. Marking | MA | Visual | 100% | Mfr. standard | Mfr. standard | Records | 3 | --- | 2 | |
| **2.0** | **IN PROCESS INSPECTION** | | | | | | | | | | | |
| 2.1 | After machining,<br>i, Body<br>ii Bonnet<br>iii Plug<br>iv Valve Stem<br>v seat ring/cage | 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 | |
| **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/ ASME B16.34 | 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% | Mfr. Procedure | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 |
| | | 2. Opening/Closing time | MA | Measurement | 100% | Mfr. Procedure | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 |
| | | 3. Linearity/cam characteristic | MA | Measurement | 100% | Mfr. Procedure | 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

PEM :: C&I

# STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION C
ISSUE NO. 2 REV. NO. 00 DATE: 25.05.2016
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 $ P | Agency $ W | Agency $ V | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 4. Repeatability | MA | Measurement | 100% | Mfr. Procedure | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 |
| | | 5. Hysteresis | MA | Measurement | 100% | Mfr. Procedure | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 |
| | | 6. Sensitivity | MA | Measurement | 100% | Mfr. Procedure | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 |
| | | 7. Accuracy (Overall) | MA | Measurement | 100% | Mfr. Procedure | Approved drg. / data sheet | Test Report | 2 | 1 | 1 | Refer Note-4 |
| | | 8. Control Valve characteristics / CV Test | MA | ♦Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%) | One per type | Mfr. Procedure | 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% | Mfr. Procedure | 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 | Approved drg./ data sheet | Records | 2 | 1 | 1 | Refer Note-4 |
| | | 11. Pre defined valve position in case of air failure | MA | Visual | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Certificate | 2 | 1 | 1 | |
| | | 12. Cleanliness, painting, stamping (for direction of flow), Tag No. | MA | Visual and dimensional, paint thickness | 100% | Mfr. Procedure | Approved drg./ data sheet | Test Certificate | 2 | 1 | 1 | |
| | | 13. Surface Quality | MA | Visual | 100% | MSS-SP-55 | MSS-SP-55 | Test Certificate | 3/2 | --- | 2,1 | |

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

PEM :: C&I

# STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION C
ISSUE NO. 2 REV. NO. 00 DATE: 25.05.2016
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 $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| **5.0** | **AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)** | | | | | | | | | | | |
| 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 | --- | --- | Certificate of Conformance (C.O.C) |
| 5.2 | Air filter regulator | 1. Normal air consumption | MA | Measurement | Each type | Mfr. Standard | No leakage | Test Certificate | 3/2 | --- | --- | (C.O.C) |
| | | 2. Overall leakage | MA | Visual (soap solution) | 100 % | Mfr. Standard | No leakage | Test Certificate | 3/2 | --- | --- | (C.O.C) |
| 5.3 | Air lock relay | Performance Test | MA | Leakage test | 100% | Mfr. Standard | No leakage | Test Certificate | 3/2 | --- | --- | (C.O.C) |
| 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 | --- | (C.O.C) |
| 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 | --- | --- | (C.O.C) |
| | | 2. Degree of Protection | MA | IP/NEMA test | Each type | Relevant Standard | Relevant Standard | Test Certificate | 3 | --- | --- | (C.O.C) |
| | | 3. Linearity | CR | Measurement | 100% | Approved drg. / data sheet / | Approved drg. / data sheet / | Inspection Report | 2 | --- | --- | (C.O.C) |
| | | 4. Hysterisis | CR | Measurement | 100% | Approved drg. / data sheet / | Approved drg. / data sheet / | Inspection Report | 2 | --- | --- | (C.O.C) |
| 5.6 | Smart Positioner | 1. Physical Verification Make/Model | MA | Visual | 100% | Approved drg. / data sheet | Approved drg. / data sheet | Test Certificate | 2 | --- | --- | (C.O.C) |

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 C
ISSUE NO. 2 REV. NO. 00 DATE: 25.05.2016
SHEET 6 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 | |
| | (As Applicable) | 2. Degree of Protection | MA | IP/NEMA test | Each type | Relevant Standard | Relevant Standard | Test Certificate | 3 | --- | --- | (C.O.C) |
| | | 3. Linearity | CR | Measurement | 100% | Approved drg. / data sheet / | Approved drg. / data sheet / | Inspection Report | 2 | --- | --- | (C.O.C) |
| | | 4. Hysterisis | CR | Measurement | 100% | Approved drg. / data sheet / | Approved drg. / data sheet / | Inspection Report | 2 | --- | --- | (C.O.C) |
| | | 5. Calibration with Hand Held Communicator | MA | Measurement | Each type | Mfr. Standard | Mfr. Standard | Test Certificate | 2 | --- | --- | (C.O.C) |
| **6.0** | **PAINTING** | Soundness of Painting | MA | Visual and Measurement | 100% | Mfr. Standard | Mfr. Standard | Inspection Report | 2 | --- | --- | 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. In case valid CV test certificate for a similar control valve (same size, same CV, same trim characteristics) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if called for in the Data sheets.
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), C.O.C's(Certificates of Conformance) shall be submitted to BHEL for verification and acceptance.

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

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# TYPE TEST REQUIREMENTS

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **1.00.00** | **TYPE TEST REQUIREMENTS** |
| 1.01.00 | General Requirements |
| 1.01.01 | The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. If the bidder proposes a different standard/code from that indicated at table 3.00.00, same is acceptable provided the equivalence of the proposed standard is established by the bidder. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.<br><br>(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.<br><br>(b) For the rest, submission of type test results and certificate shall be acceptable provided.<br><br>i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.<br><br>ii. There has been no change in the components from the offered equipment & tested equipment.<br><br>iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.<br><br>(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account. |
| 1.01.02 | As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer. |
| 1.01.03 | The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion. |
| 1.01.04 | For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out. |
| 1.01.05 | The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **2.00.00** | **SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS** |
| 2.01.00 | The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below:<br><br>i) Surge Withstand Capability ( SWC) for Solid State Equipments/ Systems<br><br>All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.<br><br>ii) Dry Heat test as per IEC-68-2-2 or equivalent.<br><br>iii) Damp Heat test as per IEC-68-2-3 or equivalent.<br><br>iv) Vibration test as per IEC-68-2-6 or equivalent.<br><br>v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent.<br><br>vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent.<br><br>vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent.<br><br>Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**3.00.00** **TYPE TEST REQUIREMENT FOR C&I SYSTEMS**

| Sl. No | Item | Test Requirement | Standard | Test To Be Specifically Conducted | NTPC's Approval Req. On Test Certificate |
|---|---|---|---|---|---|
| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 |
| 1 | Elect. Metering instruments | As per standard (col 4) | IS-1248 | No | Yes |
| 2 | Transducers | As per standard (col 4) | IEC-60688,IS12784 | No | Yes |
| 3 | Thermocouple | Degree of protection test | IS-13947 | No | No |
| 4 | RTD | As per standard (col 4) | IEC-60751 | No | No |
| 5 | Electronic transmitter | As per standard (col 4) | BS-6447 / IEC-60770 | No | Yes |
| 6 | E/P converter | As per standard (col 4) | Mfr. standard | No | No |
| 7 | Dust emission monitor | Degree of protection test | IS-13947 | No | Yes |
| 8 | Instrumentation Cables Twisted & Shielded* | | | | |
| | -Conductor | Resistance test | VDE-0815 | No | Yes |
| | | Diameter test | IS-10810 | No | Yes |
| | | Tin Coating test (Persul-phate test) | IS-8130 | No | Yes |
| | -Insulation | Loss of mass | VDE 0472 | No | Yes |
| | | Ageing in air ovens** | VDE 0472 | No | Yes |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS | | | | |
|---|---|---|---|---|---|
| | | Tensile strength and elongation test before and after ageing** | VDE 0472 | No | Yes |
| | | Heat shock | VDE 0472 | No | Yes |
| | | Hot deformation | VDE 0472 | No | Yes |
| | | Shrinkage | VDE 0472 | No | Yes |
| | | Bleeding & blooming | IS-10810 | No | Yes |
| | -Inner sheath*** | Loss of mass | VDE 0472 | No | Yes |
| | | Heat shock | VDE 0472 | No | Yes |
| | | Cold bend/ cold impact test | VDE 0472 | No | Yes |
| | | Hot deformation | VDE 0472 | No | Yes |
| | | Shrinkage | VDE 0472 | No | Yes |
| | -Outer sheath | Loss of mass | VDE 0472 | No | Yes |
| | | Ageing in air ovens** | VDE 0472 | No | Yes |
| | | Tensile strength and elongation test before and after ageing** | VDE 0472 | No | Yes |
| | | Heat shock | VDE 0472 | No | Yes |
| | | Hot deformation | VDE 0472 | No | Yes |
| | | Shrinkage | VDE 0472 | No | Yes |
| | | Bleeding & blooming | IS-10810 | No | Yes |
| | | Colour fastness to water | IS-5831 | No | Yes |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS | | | | |
|---|---|---|---|---|---|
| | | Cold bend/ cold impact test | VDE-0472 | No | Yes |
| | | Oxygen index test | ASTMD-2863 | No | Yes |
| | | Smoke Density Test | ASTMD-2843 | No | Yes |
| | | Acid gas generation test | IEC-60754-1 | No | Yes |
| | -fillers | Oxygen index test | ASTMD-2863 | No | Yes |
| | | Acid gas generation test | IEC-60754-1 | No | Yes |
| | -AL-MYLAR shield | Continuity test | | No | Yes |
| | | Shield thickness | | No | Yes |
| | | Overlap test | | No | Yes |
| | -Over all cable | Flammability Test | IEEE 383 | No | Yes |
| | | Swedish Chimney Test | SEN 4241475 | No | Yes |
| | | Noise interference | IEEE Trans-actions | No | Yes |
| | | Dimensional checks | IS 10810 | No | Yes |
| | | Cross talk | VDE-0472 | No | Yes |
| | | Mutual capacitance | VDE-0472 | No | Yes |
| | | HV test | VDE-0815 | No | Yes |
| | | Drain wire continuity | | No | Yes |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

* 1.0 All cables to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last Ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests either in an independent laboratory or at manufacturer's works in presence of Owner's representative under this contract free of cost to the Owner and submit the reports for approval.

**These tests shall be carried out as per VDE0207 Part 6 & ASTMD-2116 for TEFLON insulated & outer sheathed cables

***Applicable for armoured cables only

9 DC Power Supply System (Applicable for each model and rating)

1)The Type Test reports for offered rectifier module and the controller module irrespective of the rectifier bank shall be acceptable

| | | | |
|---|---|---|---|
| Surge Withstand Capability( SWC) | ANSI 37.90.1/ IEEE-472,EN 61000-4-12 | No | Yes |
| Dry Heat Test | IEC-68-2-2 orı equivalent | No | Yes |
| Damp Heat test | IEC-68-2-3 orı equivalent | No | Yes |
| Vibration test | IEC68-2-6 orı equivalent | No | Yes |
| Electrostatic discharge test | EN 61000-4-2 orr equivalent | No | Yes |
| Radio frequency immunity test | EN-61000-4-3 orr equivalent | No | Yes |
| Electromagneti c field immunity | EN 61000-4-3 orr equivalent | No | Yes |
| Degree of Protection | IS-13947 oı equivalent | No | Yes |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | | | |
|---|---|---|---|---|---|
| 10 | Battery ## | As per standard (col 4) | IS-10918 (Ni-Cd Batteries) | No | Yes |
| | | | IS-1652 (Lead Acid Plante Batteries) | No | Yes |

11 NOT APPLICABLE

12 UPS ( Applicable for each model and rating )

1) Type Test reports of same series of UPS with similar PCB's cards and controllers as the target UPS system shall be acceptable.

2) For Dry heat, Damp heat and vibration, the tests conducted on individual PCB's shall be acceptable.

| | | | |
|---|---|---|---|
| Surge Withstand Capability( SWC) | ANSI 37.90.1, IEEE-472,EN 61000-4-12 | No | Yes |
| Dry Heat Test | IEC-68-2-2 or equivalent | No | Yes |
| Damp Heat test | IEC-68-2-3 or equivalent | No | Yes |
| Vibration test | IEC68-2-6 or equivalent | No | Yes |
| Electrostatic discharge test | EN 61000-4-2 orr equivalent | No | Yes |
| Radio frequency immunity test | EN-61000-4-3 orr equivalent | No | Yes |
| Electromagnetic field immunity | EN 61000-4-3 orr equivalent | No | Yes |
| Degree of protection test | IS-13947 | No | Yes |
| Fuse Clearing Capability | Approved procedure | No | Yes |
| Short Circuit current capability | IEC 60146-2 | No | Yes |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | | | | |
|---|---|---|---|---|---|
| | 13 | Voltage Stabilisers | Over Load Test | Approved procedure | No | Yes |
| | | | Temp rise test without redundant fans | Approved procedure | No | Yes |
| | 14 | Public Address System | | | | |
| | | - Amplifiers | As per standard (col 4) | IS 9302, Part-II | No | Yes |
| | | Microphones | As per standard (col 4) | IS 9302, Part-III<br>IS 15482:2004/<br>IEC 61842(2002) | No | Yes |
| | | Loudspeaker | As per standard (col 4) | IS 9302, Part-IV | No | Yes |
| | 15 | LIE / LIR | Degree of protection test | IS-13947 | No | Yes |
| | 16 | Flue gas analyzers | Degree of protection test | IS-13947 | No | Yes |
| | 17 | Master Clock | Functional test | As per approved procedure | No | Yes |
| | 18 | CJC Box | Degree Of protection test | IS-13947 | No | Yes |
| | 19 | Junction Box | Degree Of protection Test | IS-13947 | No | Yes |
| | 20 | OPC Data Access Server, Data Exchange Server & | OPC Compliance Testing | | No | Yes (Self certification is also |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| | | | | | |
|---|---|---|---|---|---|
| | Historical Data Access Server | | | | acceptable) |
| 21 | Conductivity Type Level Switch | Degree of protection test | IS-2147 | No | No |
| 22 | Local Gauges | Degree of protection test | IS-2147 | No | No |
| 23 | Process actuated Switches | Degree of protection test | IS-2147 | No | No |
| 24 | Control Valves | CV test | ISA 75.02& 75.11 | No | Yes |
| 25 | PLCs | As per standard (Col 4) | IEC 1131 | No | No |
| 26 | Flow Nozzle Orifice plates | Calibration | ASME PTC<br>BS 1042 | No | Yes |

## The contractor shall submit for Employers approval the reports of all the type test as per latest IS-10918 carried out within last ten years from the date of Bid opening and the test(s) should have been either conducted at an independent laboratory or in presence / owners representative. The complete type test reports shall be for any rating of Battery in a particular group based on plate dimensions being manufactured by supplier.

**Note:**

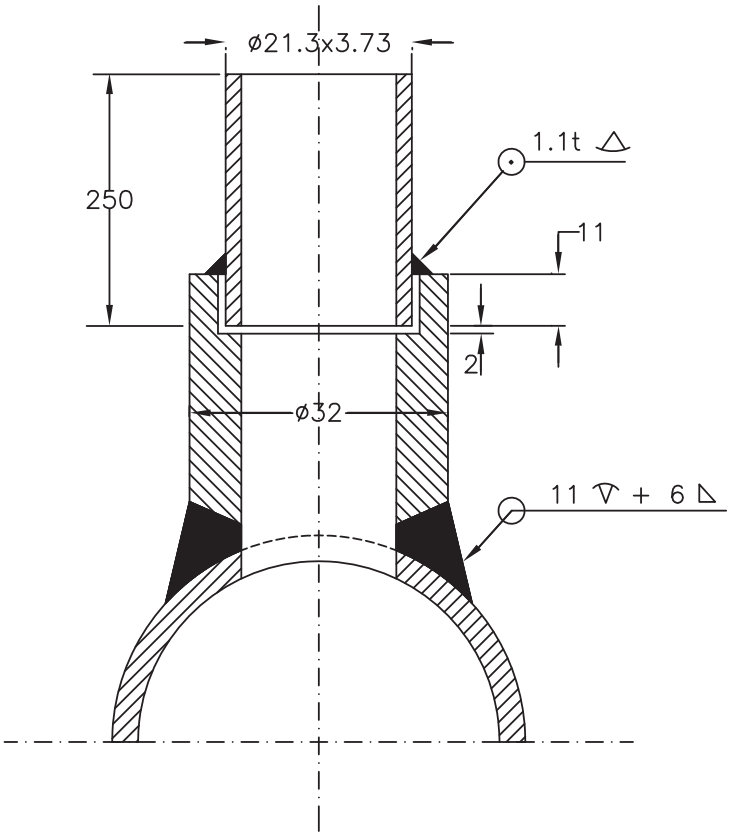
Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# INSTRUMENT STUB DETAILS

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01




NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ( 1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 250Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.

TITLE :

INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

(SYSTEM PRESS UPTO 40Kg/Cm2, TEMP< 400 Deg C )

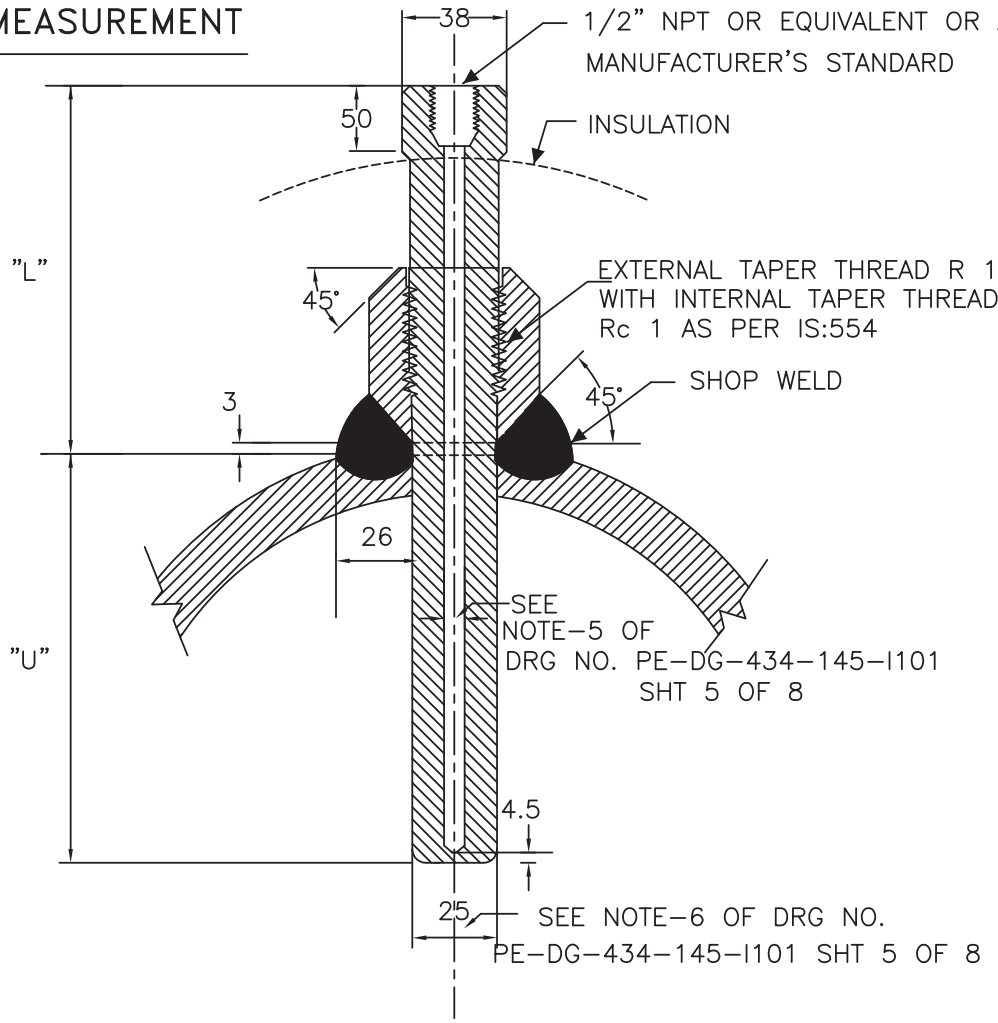
DRG. NO. PE-DG-434-145-I101

REV. 00

SH. 04 OF 08 SHS.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## TEMP. MEASUREMENT

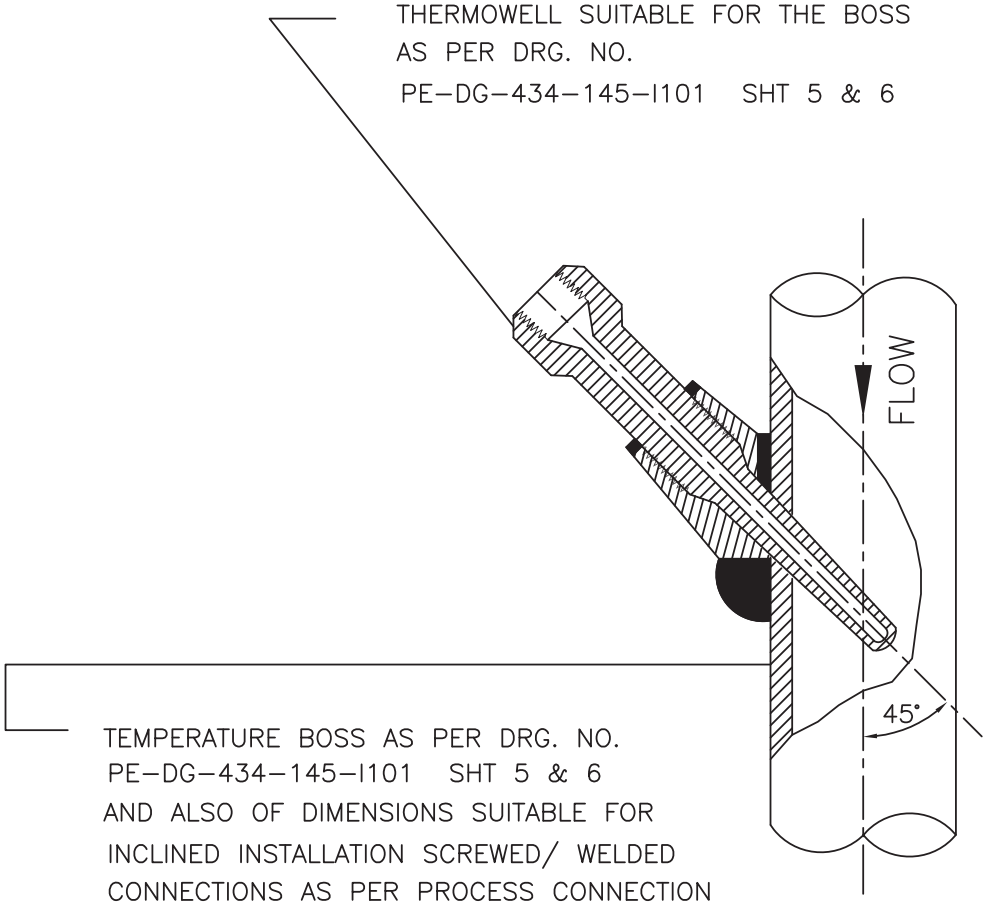



### NOTES :–

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESS/ TEMP. BELOW 40 KG/CM2(g)/400°C.
2. SEE NOTES–2 TO 9 IN SHT. 5 OF 8 OF THIS DRG.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

| | | |
|---|---|---|
| भेल BHEL | TITLE : INST. STUB DETAILS (TEMP) (APPLICABLE FOR PIPE SIZE ABOVE 4") [PROCESS PRESS < 40 Kg/Cm2 (g),TEMP < 400 ℃] | DRG. NO. PE–DG–434–145–I101 REV. 00 SH. 06 OF 08 SHS. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01




## NOTES :–

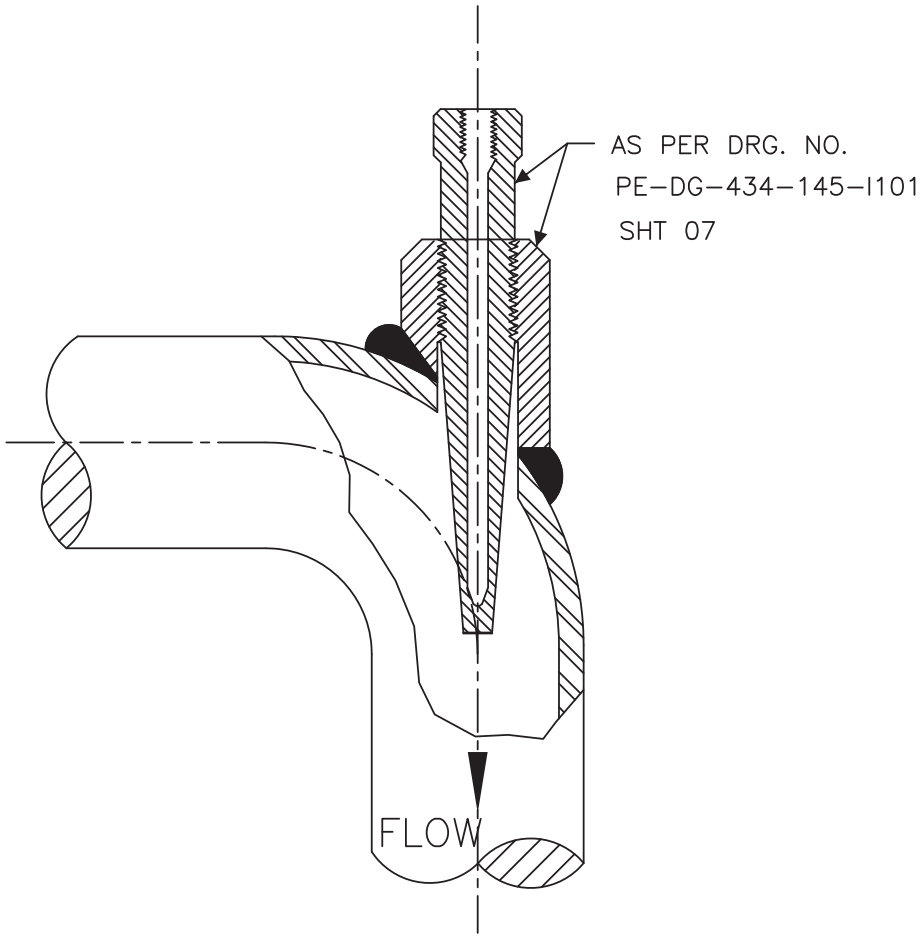
1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF INSTALLED THERMOWELL).

TITLE :

THERMOWELL INSTALLATION

DRG. NO.
PE–DG–434–145–I101
REV. 00
SH. 07 OF 08 SHS.

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01




NOTES :-

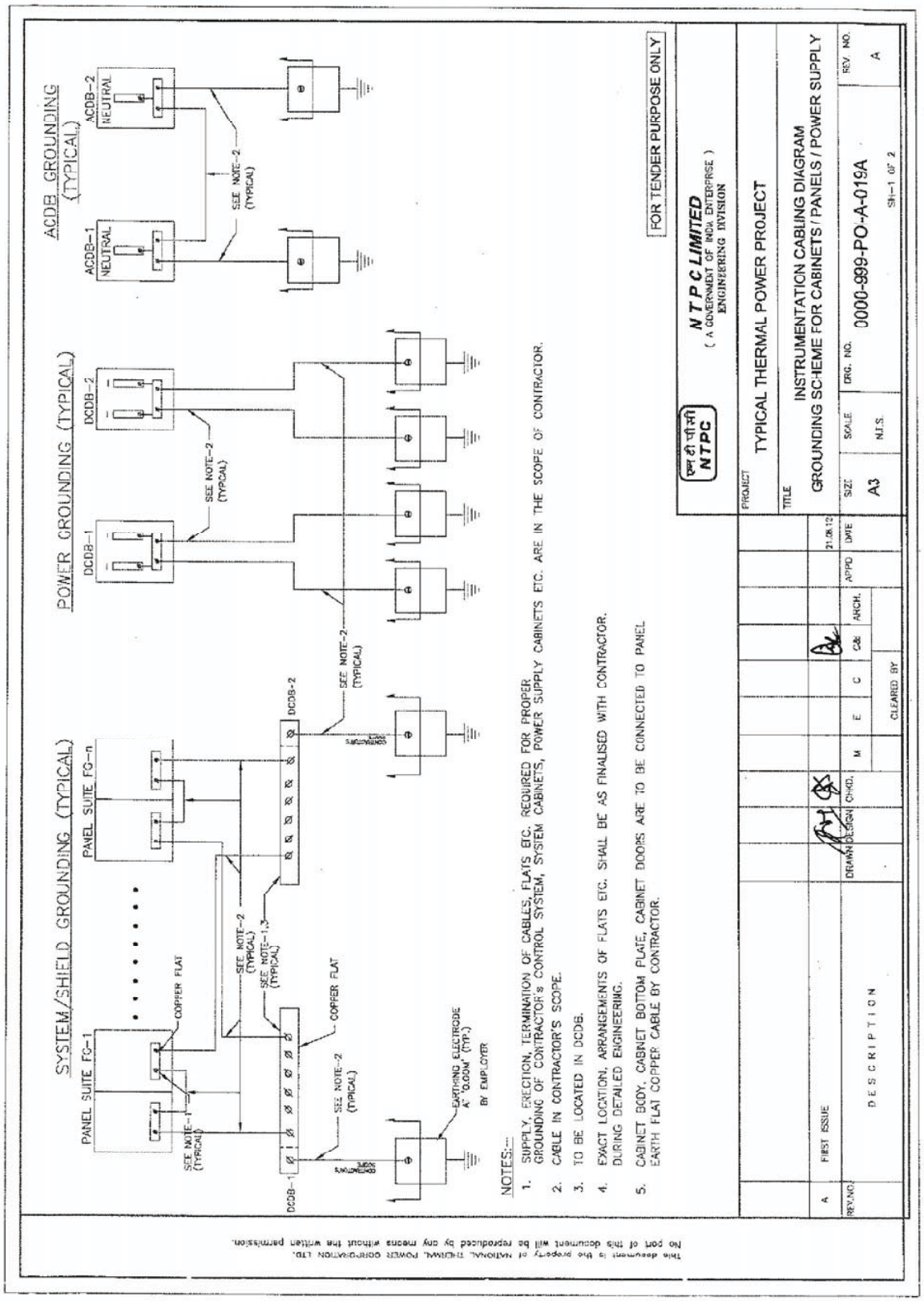
1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.

| | | |
|---|---|---|
| BHEL | TITLE :<br>THERMOWELL INSTALLATION<br>(IN BEND PIPES) | DRG. NO.<br>PE-DG-434-145-I101<br>REV. 00<br>SH. 08 OF 08 SHS. |

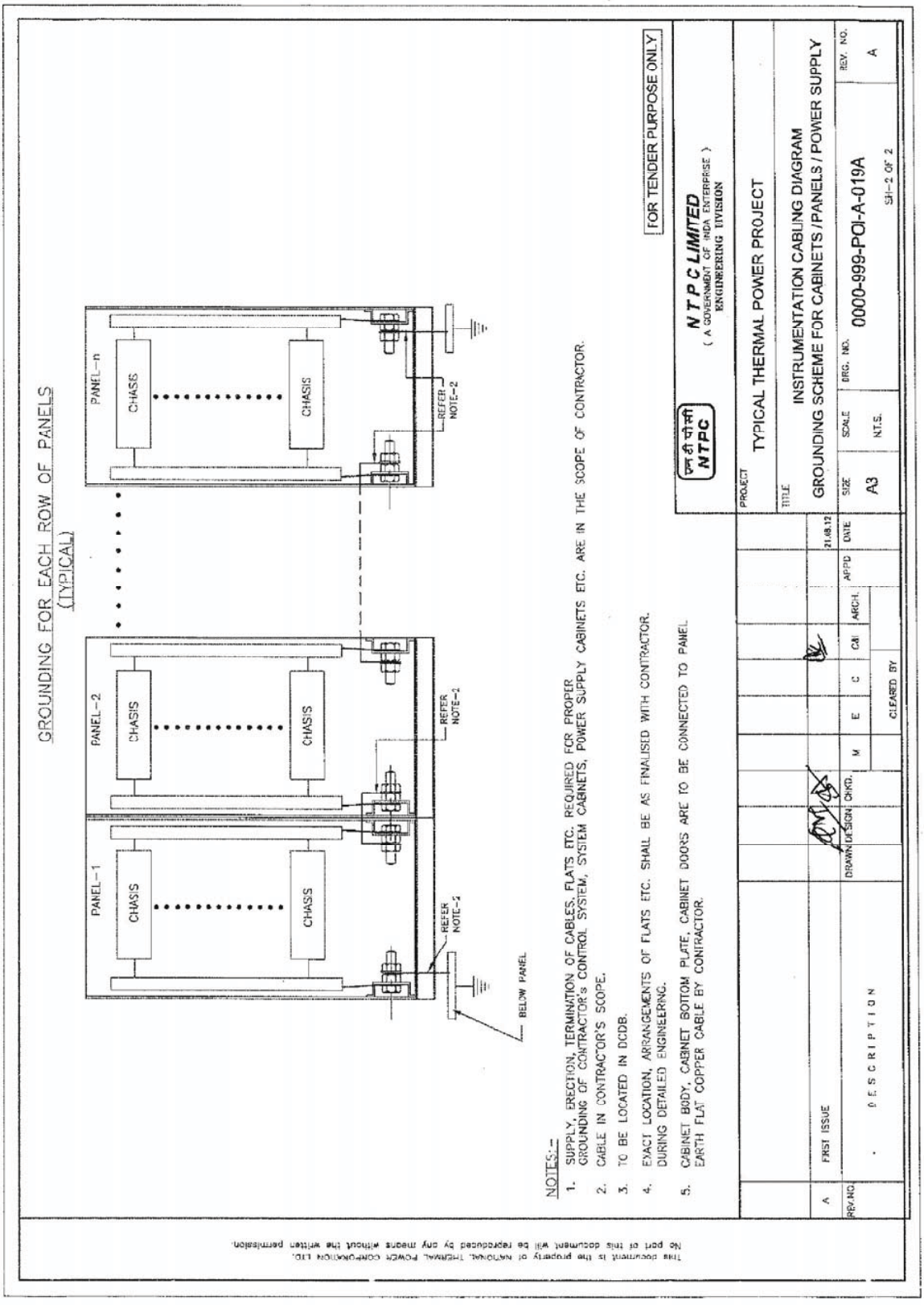
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# INSTRUMENT INSTALLATION DRAWING

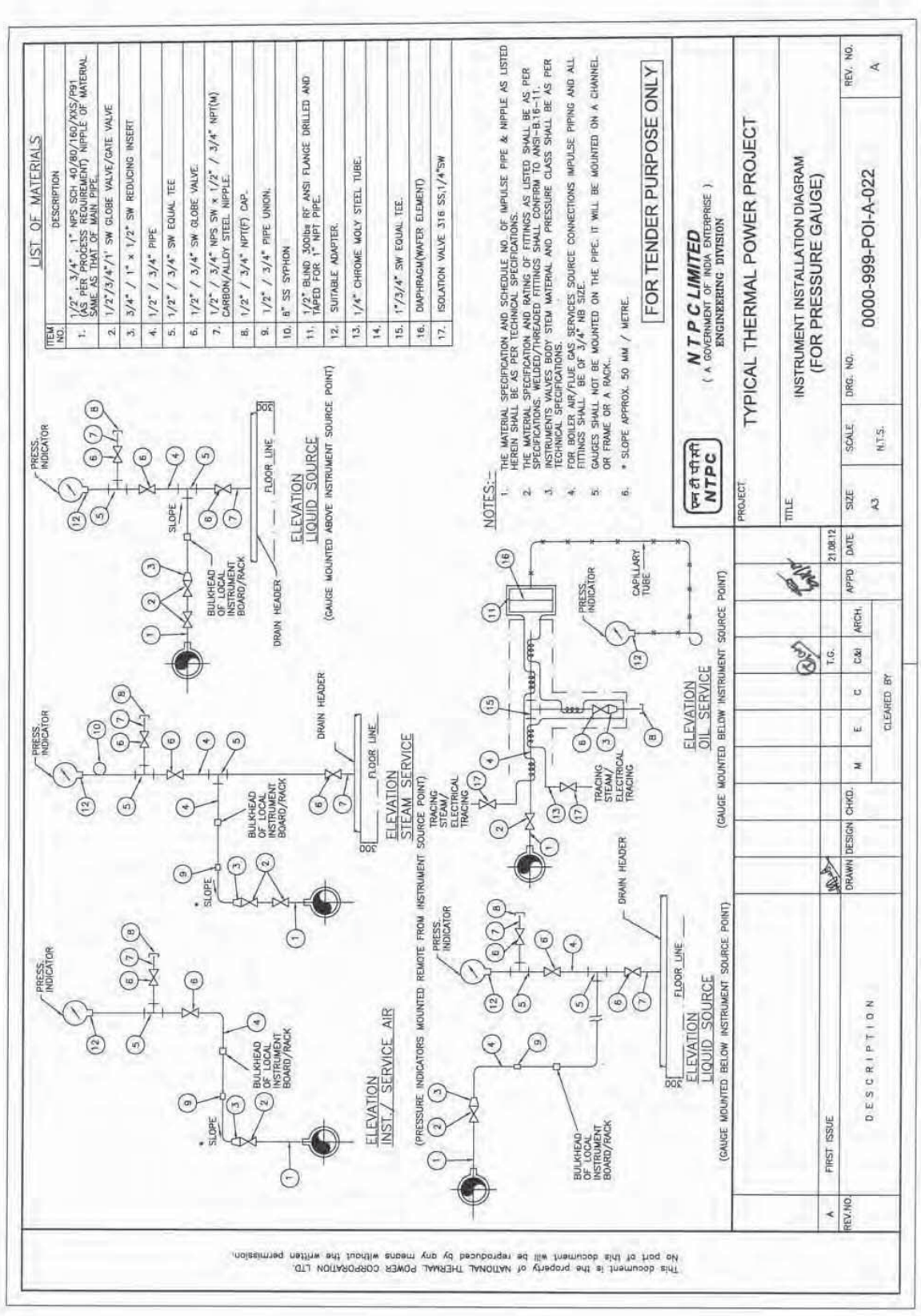
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



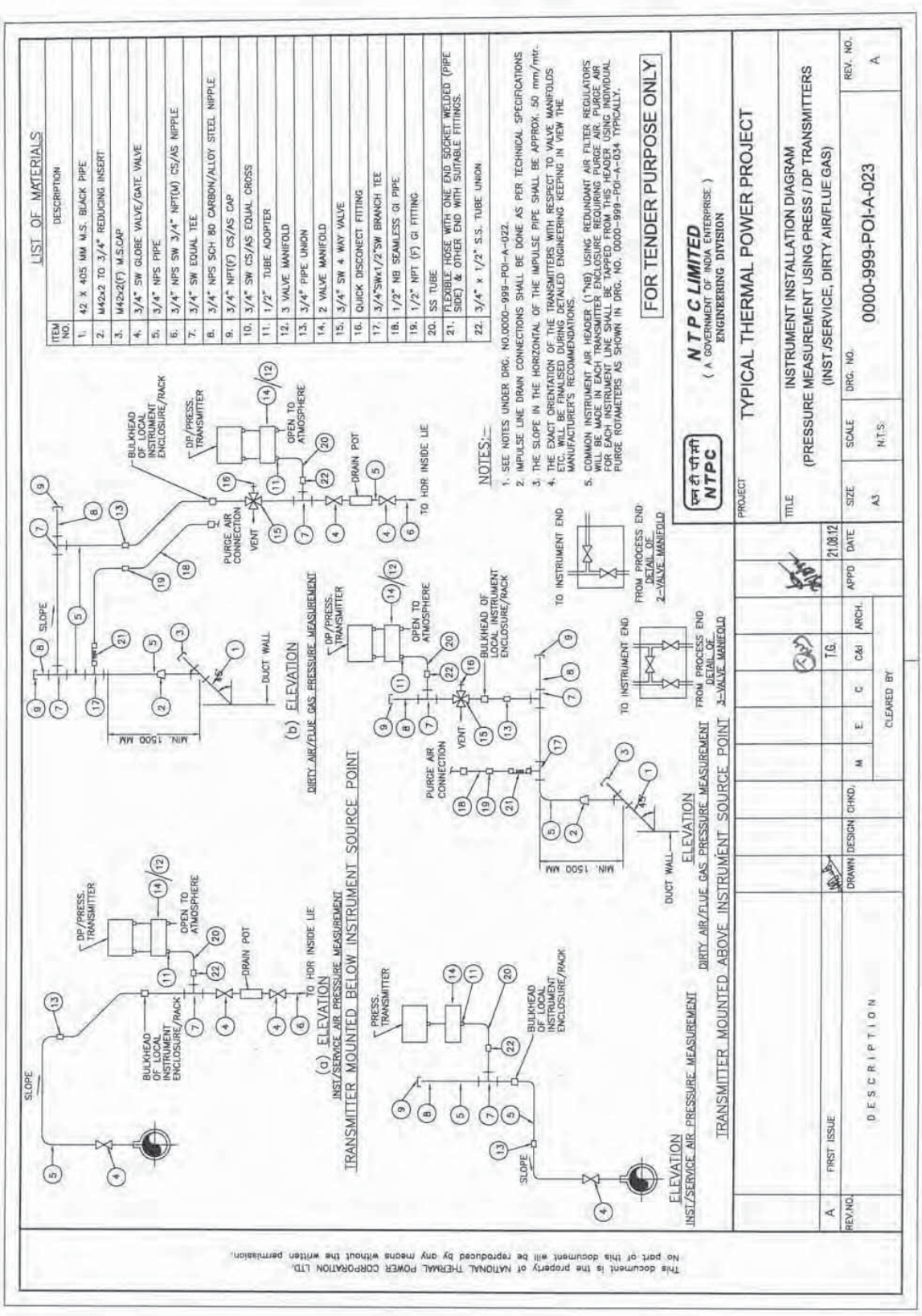
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



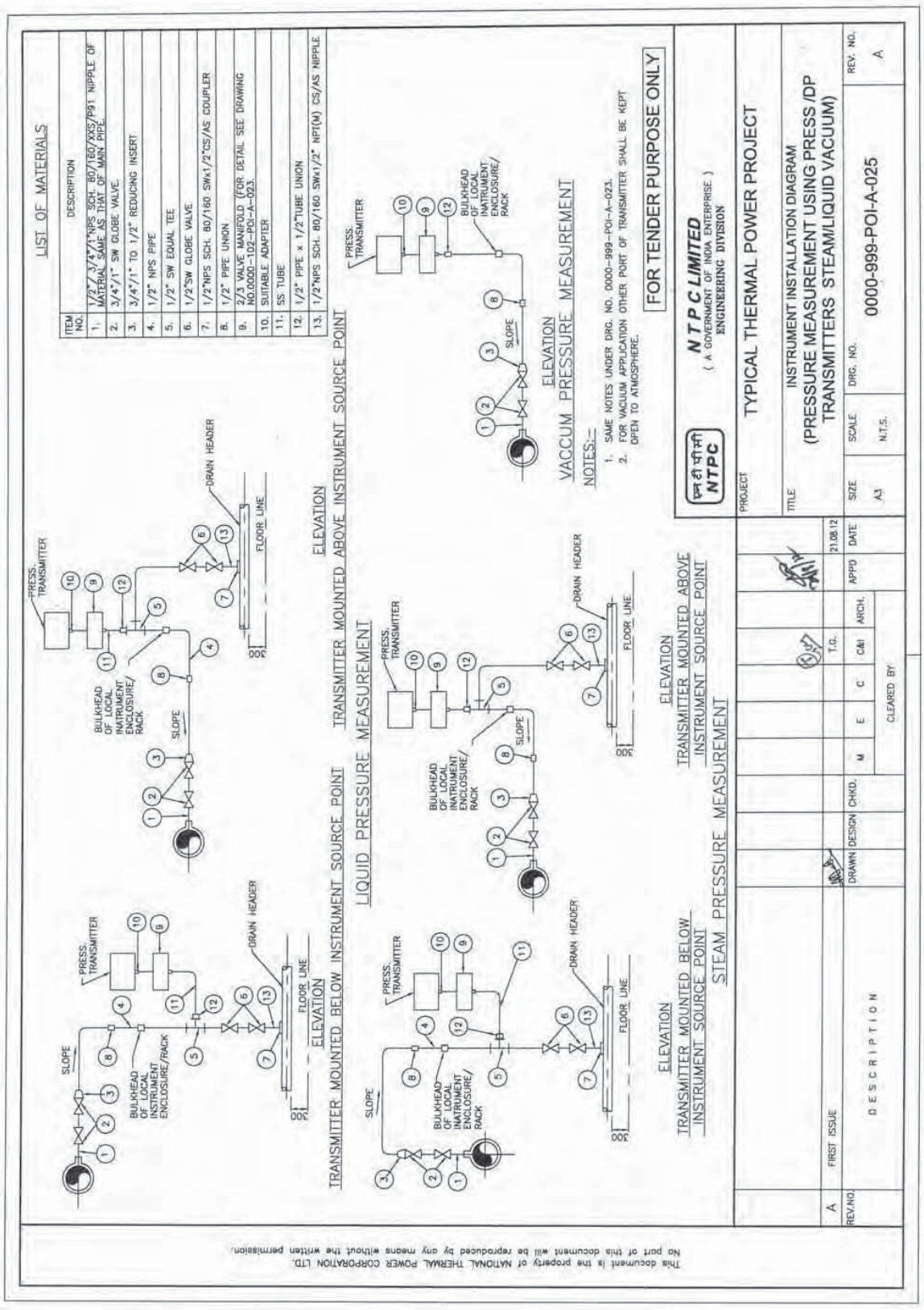
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



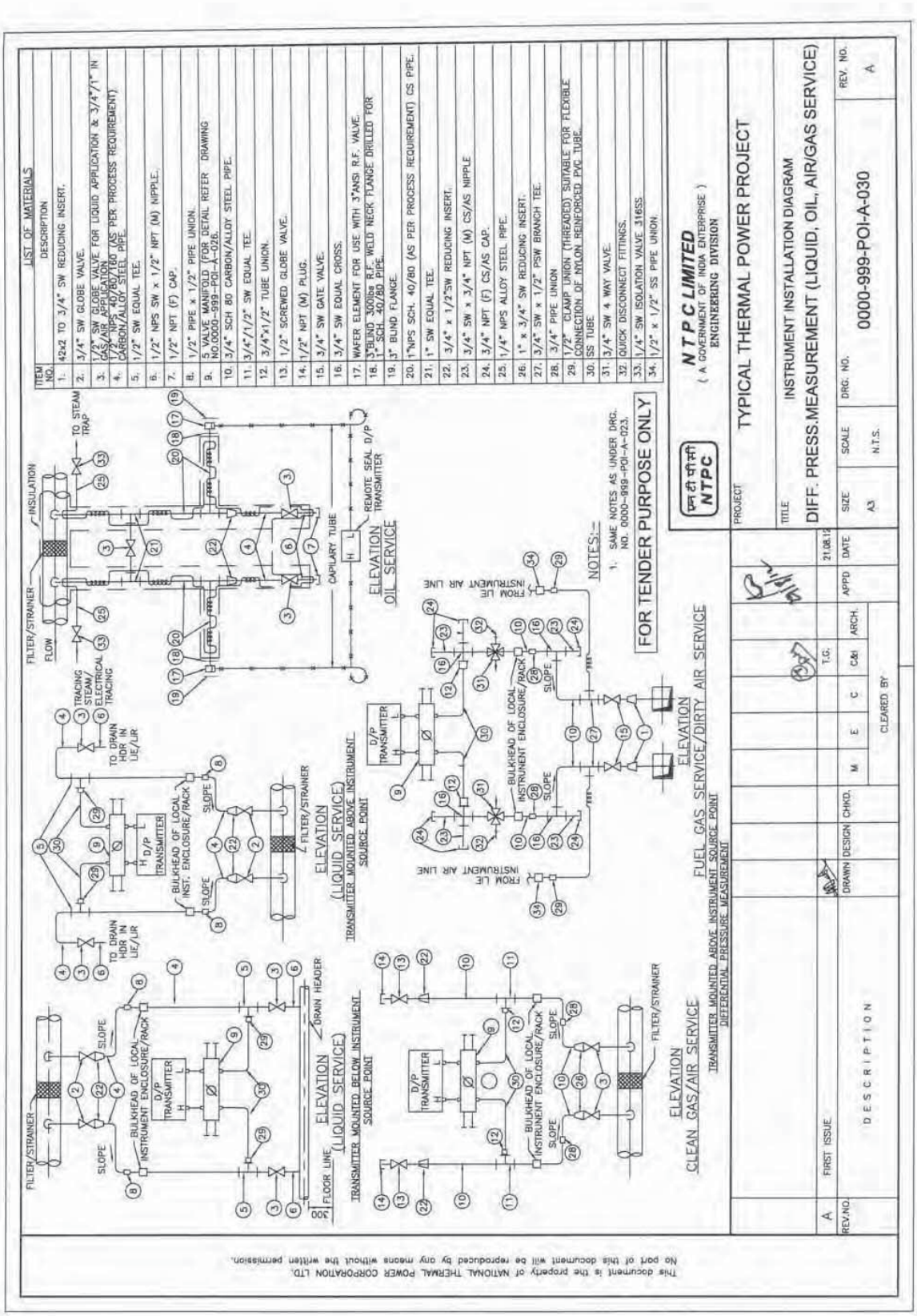
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



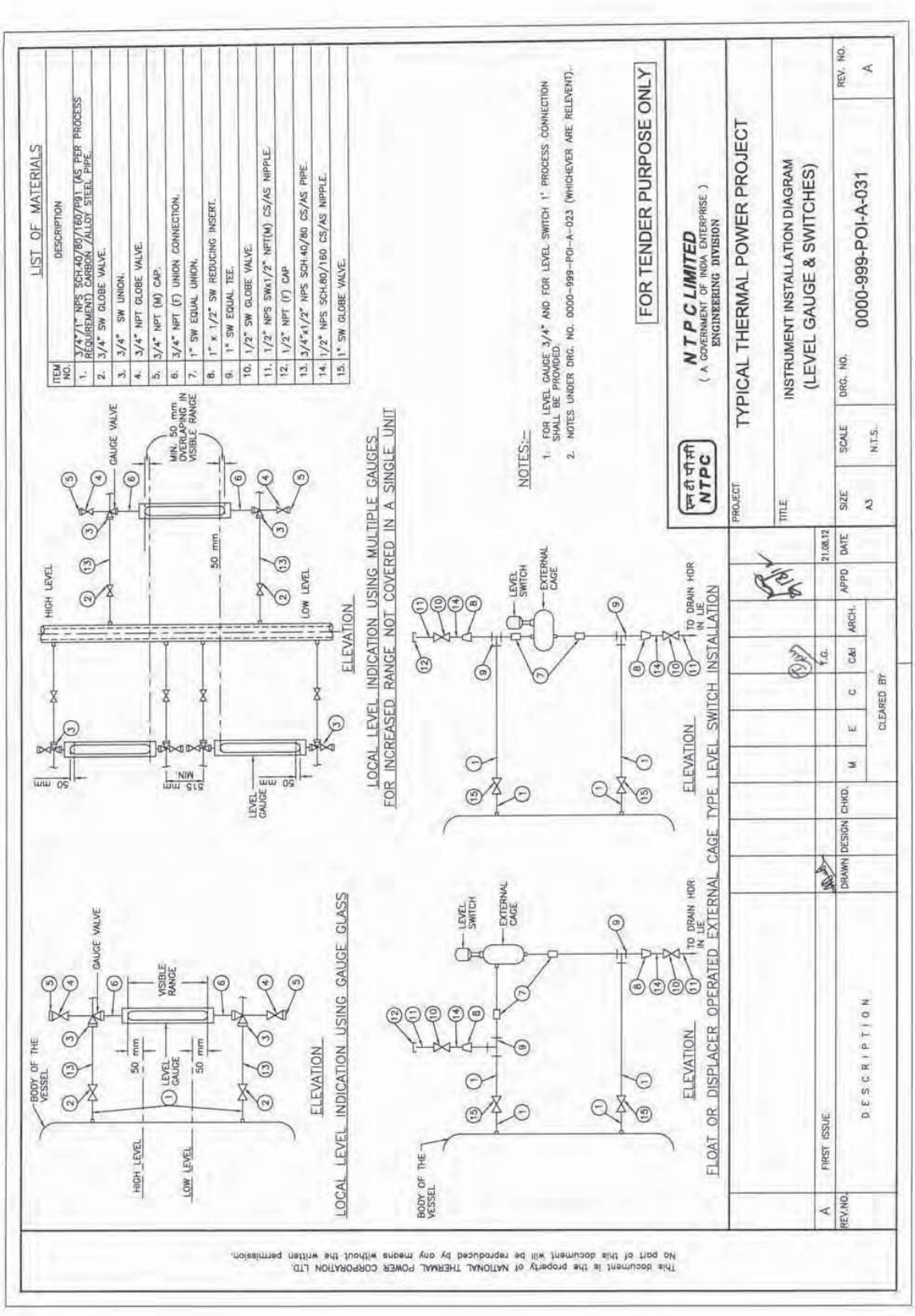
This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01



| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

## PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

1.01.00 The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.

1.01.01 **IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS**

1.01.02 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

| | |
|---|---|
| Impulse Pipes, Tubes (Material, Rating) | ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70 |
| Valves (Material, Pr. Class, Size) | ASTM A182/ASTM A105 as per ASME 16.34 |
| Fittings (Size, Rating, Material) | ANSI B31.1, ANSI B31.1a, ASME B16.11-2009 |
| Installation Schemes | BS 6739-2009, ANSI/ISA 77.70 |

Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 $Kg/cm^2$ or Temp>280 $^oC$. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.

1.01.03 The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:

| Manifold | Application/Measurement |
|---|---|
| 2 Valve | Pressure measurements using pressure transmitters/pressure switches |
| 3 Valve | Pressure measurements using differential pressure transmitter/ switches |
| 5 Valve | Differential Pressure, Flow and Level Measurements |

For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .

2.00.00 **AIR SUPPLY PIPING**

2.01.01 All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

2.02.00 Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.

2.03.00 The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports. |
| 2.04.00 | The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location. |
| 2.05.00 | All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch. |
| 2.06.00 | Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering. |
| 3.00.00 | **INSTALLATION AND ROUTING** |
| 3.01.01 | All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe form the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.<br><br>Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes. |
| 4.00.00 | **SHOP AND SITE TESTS** |
| 4.01.01 | The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-IIIE-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan. |
| 4.01.02 | Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1. |
| 5.00.00 | **LOCAL INSTRUMENT ENCLOSURE AND RACKS**<br><br>All transmitters, switches etc. in Boiler Turbine Generator measurements (except for all fuel oil applications) shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas like Turbine/Generator area. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels. |



This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | . |
| | The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55. |
| | The instrument racks shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. |
| | Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. |
| | Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR. |
| **5.01.00** | ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS |
| | All Dual Input temperature transmitters in Boiler Turbine Generator measurements shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like boiler area, etc. and (ii) Racks in case of covered areas like Turbine/Generator area. Integral JB shall be provided with each Enclosure and Rack. |
| | The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance. |
| | Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55. |
| | Enclosure and Racks shall be free standing type. |
| | Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. |
| | Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering. |

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

# SUB VENDOR LIST

This is part of Technical Specification No. PE-TS-434-571-A001, Rev 01

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR :BHEL Ltd | VENDOR AS APPROVED BY | DATE : 26.04.2017 |
| | CONTRACT NO : CS-9585-001-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVI-Q | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | * | | | | KOSO | Japan / Nasik | DR | | | | requirements. |
| | | * | | | | Nakikata | Japan | DR | | | | |
| | | * | | | | Parcol Spa | USA | DR | | | | |
| | | * | | | | Yamatake | Japan | DR | | | | |
| | | * | | | | BOPP & ROUTHER | Germany | DR | | | | |
| | | * | | | | KSB MIL | Alwaye | DR | | | | |
| 20 | Control valve for feedwater flow Control | II | | | | CCI | USA/Austria /Korea | A | | | | |
| | | II | | | | Dressor Masoneilan | France | A | | | | |
| | | II | | | | HORA | Germany | A | | | | |
| | | II | | | | EMERSON (Fisher) | USA/France /Japan | A | | | | |
| | | II | | | | Sempell | Germany | A | | | | |
| | | II | | | | KOSO | Japan | A | | | | |
| | | * | | | | LESLIE | USA | DR | | | | M/s BHEL will forward only three proposals after details review of NTPC Technical specification requirements. |
| | | I | | | | CCI | Sricity | A | | | | |
| | | * | | | | Parcol Spa | USA | DR | | | | |
| | | * | | | | WEIR VALVES and Controls | UK | DR | | | | |
| | | * | | | | KOSO | Nasik | DR | | | | |
| | | * | | | | KSB MIL | Alwaye | DR | | | | |
| | | I | | | | Emerson Process Management | Chennai | A | | | | |
| | | * | | | | BOMAFA Special valve solutions Pvt. Ltd. | Ahmedabad | DR | | | | |
| | | * | | | | Suzhou delan safety science and tehnology co. Ltd. | China | DR | | | | |
| 21 | Control Valve ( other than Sr. No. - 17 to 20) | II | | | | CCI | USA/Switzerland/Korea | A | | | | |
| | | II | | | | Tyco Sampell | Germany | A | | | | |
| | | II | | | | EMERSON (Fisher) | USA/France/Japan / Chennai | A | | | | |
| | | II | | | | Dressor Masoneilan | France | A | | | | |
| | | II | | | | KOSO | Japan | A | | | | |
| | | II | | | | HORA | Germany | A | | | | |
| | | II | | | | CCI | Sricity | A | | | | |
| | | II | | | | Spx Copes Vulcan | USA | A | | | | |
| | | II | | | | Dressor | Coimbatore | A | | | | |
| | | II | | | | IL | Palakkad | A | | | | |
| | | II | | | | KSB MIL | Alwaye | A | | | | |
| | | II | | | | KOSO | Palakkad | A | | | | |
| | | II | | | | EMERSON | Chennai | A | | | | |
| | | II | | | | Flow Serve | Bangalore | A | | | | |
| | | II | | | | Copes Vulcan | UK | A | | | | |
| | | II | | | | Leslie | USA | A | | | | |
| | | II | | | | Parcol Spa | Italy | A | | | | |
| | | II | | | | KOSO | Nasik | A | | | | |

Bharat Heavy Electricals Limited PS-MKTG Delhi

4.05.17

Delhi

C.R. Nader Deptt.

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR :BHEL Ltd | VENDOR AS APPROVED BY | DATE : 26.04.2017 |
| | CONTRACT NO : CS-9585-001-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVI-Q | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | II | | | | Forbes Arca | Pune | A | | | | Approvd up to 4" and 300 Class. "DR" for Higher rating and Size. |
| | | * | | | | Daume Regelarmaturean GmbH | Germany | DR | | | | M/s BHEL will forward only three proposals after details review of NTPC Technical specification requirements. |
| | | * | | | | Metso Singapore PTE ltd. | South Korea | DR | | | | |
| | | * | | | | Severn Glocon | Chennai | DR | | | | |
| | | * | | | | Spx Corporation | USA | DR | | | | |
| | | * | | | | Ringo Valvulas SL | Spain | DR | | | | |
| | | * | | | | Valvitalia SPA | Italy | DR | | | | |
| | | * | | | | R K Controls | Thane | DR | | | | |
| | | * | | | | Circor (Leslie) | Coimbatore | DR | | | | |
| | | * | | | | Spx Flow Technologies | USA | DR | | | | |
| | | * | | | | Circor (Leslie) | Coimbatore | DR | | | | |
| | | * | | | | Schenjang valve co. ltd. | China | DR | | | | |
| | | * | | | | Spx Flow Technologies | Ahamadabad | DR | | | | |
| | | * | | | | WEIR Valves and Controls | UK | DR | | | | |
| | | * | | | | WALDEMAR PRUSS ARMATURENFABRIK GMBH | Germany | DR | | | | |
| | | * | | | | BOMAFA Special valve solutions Pvt. Ltd. | Ahmedabad | DR | | | | |
| | | * | | | | Suzhou delan erdery science and tehnology co. Ltd. | China | DR | | | | |
| 22 | Temperature Transmitter | III | | | | EMERSON | U.S.A/Pawana / Singapore | A | | | Sub QR | |
| | (Single and Duel Input) | III | | | | Yokogawa | Japan | A | | | | Final testing at M/S YIL,Bangalore is also acceptable |
| | | III | | | | Mepre | USA | A | | | | |
| | | III | | | | M System | JAPAN | A | | | | |
| | | III | | | | ABB | GERMANY/ Bangalore | A | | | | |
| | | III | | | | ENDRESS & HOUSER | Aurangabad | A | | | | |
| | | * | | | | Khrone | | DR | | | | M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements. |
| | | * | | | | Tokyo Keiso | Japan | DR | | | | |
| | | * | | | | Honeywell | Pune | DR | | | | |
| | | * | | | | INOR | Sweden | DR | | | | |
| | | * | | | | P & F | Bangalore | DR | | | | |
| | | * | | | | Siemens | | DR | | | | |
| | | * | | | | Yamatake | JAPAN | DR | | | | |
| | | * | | | | Yamari | JAPAN | DR | | | | |
| | | * | | | | Foxboro | | DR | | | | |
| 23 | Conduits/Pipe(GI) | | | | | Refer Electrical List | | | | | | |
| 24 | Electronic transmitters (pressure, DP,Flow) | III | | | | EMERSON (Rosemount) | USA/ Pawana | A | | | Sub QR | |
| | | III | | | | FUJI ELECTRIC | France | A | | | | |
| | | III | | | | YOKOGAWA | JAPAN | A | | | | Testing and Calibration at M/s YIL, Bangalore is also acceptable. |

5 of 26

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

C&M Deptt.

Tadav.

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR :BHEL Ltd | VENDOR AS APPROVED BY | DATE : 26.04.2017 |
| | CONTRACT NO : CS-9585-091-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-091-QVI-Q | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | III | | | | YOKOGAWA | Bangalore | A | | | | EJA- E series 110,430,530 |
| | | III | | | | ABB | Bangalore | A | | | | Model - 2600 T |
| | | III | | | | ABB | GERMANY / Italy | A | | | | Model - 2600 T |
| | | III | | | | Siemens | France / Kalwa | A | | | | |
| | | III | | | | Honeywell | Pune | A | | | | |
| | | III | | | | Larson Automation | Daman | A | | | | SMAR Make |
| | | III | | | | Baldota | Mumbai | A | | | | SMAR Make |
| | | * | | | | ENDRESS & HOUSER | Aurangabad/ Germany | DR | | | | |
| | | * | | | | CHINO | Ghaziabad | DR | | | | |
| 25 | Thermocouples, RTD & Thermowell | III | | | | HERAUS SENSOR | GERMANY | A | | | Sub QR | |
| | | III | | | | WISE Control | Korea | A | | | | |
| | | II | | | | Tempsens | Udaipur | A | | | | |
| | | II | | | | Pyroelectric | Goa | A | | | | |
| | | II | | | | Delfin Instrumentation & Electronics Ltd | Mumbai | A | | | | |
| | | III | | | | Minco | USA | A | | | | |
| | | III | | | | OKAZAKI corporation | JAPAN | A | | | | |
| | | III | | | | Yamari | JAPAN | A | | | | |
| | | III | | | | Yamari | Singapore | A | | | | For RTD Reference list and Performance feedback is to be submitted. |
| | | III | | | | ABB(SENSYCON) | Germany | A | | | | |
| | | III | | | | EMERSON (Rosemount) | Germany | A | | | | |
| | | II | | | | EMERSON (Rosemount) | Pawane | A | | | | Imported from Emerson, Germany (make) |
| | | II | | | | Thermal Instruments(GIC) | Savantwadi | A | | | | |
| | | II | | | | Techno Instruments | Ahamadabad | A | | | | |
| | | II | | | | GOA Instrument Industries | GOA | A | | | | For Thermowell only |
| | | * | | | | GOA Instrument Industries | GOA | DR | | | | M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements. |
| | | * | | | | WIKA | Pune | DR | | | | |
| | | * | | | | Toshniwal Industries | Ajmer | DR | | | | |
| | | * | | | | E & H | Aurangabad | DR | | | | |
| | | * | | | | Neestech | Vapi | DR | | | | |
| | | * | | | | Instrustial Instruments | Kolkata | DR | | | | |
| | | * | | | | Exotherm | Thane | DR | | | | |
| | | * | | | | Baumer Technologies | Vapi | DR | | | | |
| | | * | | | | Eland Engineering | Nokia | DR | | | | |
| | | * | | | | Siemens India | Gurgaon | DR | | | | |
| | | II | | | | Jindal Electronics | Roorkee | A | | | | For Gantralor turbine & Motor |
| 26 | Ultrasonic type level Transmitter | III | | | | E & H | Aurangabad/ Germany | A | | | Sub QR | |
| | | III | | | | EMERSON | Pawane | A | | | | |
| | | III | | | | SIEMENS MILTRONICS | CANADA | A | | | | |
| | | III | | | | Nivelco | Hungary | A | | | | |
| | | * | | | | Vega | Germany | DR | | | | |

6 of 26

Bharat Heavy Electricals Limited PS-MKTG Delhi

C & M Deptt.

Afadav,







214

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACT NO : CS-9585-001-2 | VENDOR AS APPROVED BY | DATE : 26.04.2017 |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVIQ | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | * | | | | Khrone | France / USA / Pune | DR | | | | M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements. |
| | | * | | | | Yokogawa | Bangalore | DR | | | | |
| | | * | | | | P&F | Germany | DR | | | | |
| | | * | | | | Magnetrol | Belgium | DR | | | | |
| | | * | | | | ABB | Germany / India | DR | | | | |
| | | * | | | | Forbes Marshall | Pune | DR | | | Sub QR | |
| 27 | Orifice plate assembly | III | | | | Instrumentation Limited | Palghat | A | | | | |
| | | III | | | | Microprecision | Palwal | A | | | | |
| | | III | | | | Starmech | Pune | A | | | | |
| | | III | | | | Flow Star | Faridabad | A | | | | |
| | | III | | | | SEIKO | Austria | A | | | | |
| | | III | | | | MINCO India Pvt. Ltd. | GOA | A | | | | Up to 32" |
| | | III | | | | MINCO India Flow Elements Pvt. Ltd. | GOA | A | | | | Up to 28" |
| | | III | | | | WISE Control | Korea | A | | | | |
| | | III | | | | T M Technomatic | Italy | A | | | | |
| | | * | | | | IEPL | Hyderabad | DR | | | | |
| | | * | | | | Engg. Specialities | Kolkata | DR | | | | |
| | | * | | | | BALIGA | CHENNAI | DR | | | | |
| | | * | | | | Pyroelectric | Mumbai | DR | | | | |
| | | * | | | | Hydropneumatics | Mapusa | DR | | | | |
| | | * | | | | Tansa Equipment Pvt. LTd. | Thane | DR | | | | |
| | | * | | | | Dynamic Fluid Vales Pvt. Ltd. | Belgium | DR | | | | |
| 28 | Pressure, DP Gauge | III | | | | BUDENBERG | UK | A | | | | |
| | | III | | | | ASHCROFT | USA/Germany/ India | A | | | | |
| | | III | | | | Wika | GERMANY | A | | | | |
| | | III | | | | WISE Control | Korea | A | | | | |
| | | III | | | | Nagano KEIKI | Japan | A | | | | |
| | | III | | | | H.Guru South India | Bangalore | A | | | | Not for MS & FW application |
| | | III | | | | A.N. Instruments | Kolakatia | A | | | | Not for MS & FW application |
| | | III | | | | Gauge Bourdon | Panvel | A | | | | |
| | | III | | | | Goa Thermostatic | GOA | A | | | | Not for MS & FW application |
| | | III | | | | Wika | Pune | A | | | | DR for MS & FW application |
| | | III | | | | Baumer | Vapi | A | | | | DR for MS & FW application |
| | | III | | | | Precision mass products Pvt. Ltd. | Gandhinagar | A | | | | Not for MS & FW application |
| | | III | | | | H Guru | Rishra/Muzaffarpur | A | | | | Not for MS & FW application |
| | | * | | | | US Gauge | USA | DR | | | | |
| | | * | | | | Winters | USA | DR | | | | |
| | | III | | | | Forbes Marshall | Hyderabad | A | | | | |
| | | * | | | | Manometer | Mumbai | DR* | | | | |
| | | III | | | | Walchandnagar Industries Ltd. | Dharwad | A | | | | |
| | | III | | | | Nesstech | Vapi | A | | | | DP Gauge for M/s Nesstech, Japan |
| | | * | | | | Gauges Bourdon | UK | DR | | | | |
| | | * | | | | Fisher Mess | Germany | DR | | | | |

7 of 26

Bharat Heavy Electricals Limited PS-MKTG Delhi

C & M Deptt. Patratu Vidyut Utpadan Nigam Limited Distt-Ramgarh (Jharkhand)

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X660MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR : BHEL Ltd | VENDOR AS APPROVED BY | DATE : 26.04.2017 |
| | CONTRACT NO : CS-9585-001-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVIQ | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | * | | | | Protech Control | Kolkata | DR | | | | |
| | | * | | | | New Scientific | Kolkata | DR | | | | |
| | | * | | | | PTCI | Kolkata | DR | | | | |
| 29 | Level gauge (Transperent & Reflex, Tubular type) | III | | | | Main Contractor approved Sources | | A | | | | |
| 30 | Press, DP, Vaccum Switch | III | | | | SOR | USA | A | | | Sub QR | |
| | | III | | | | DRESSOR (ASHCROFT) | USA/Germany | A | | | | |
| | | III | | | | ITT BARTON | USA | A | | | | |
| | | III | | | | HERION | GERMANY | A | | | | |
| | | III | | | | BARKSDALE | GERMANY | A | | | | |
| | | * | | * | | Nagano KEIKI | Japan | DR | | | | |
| | | II | | | | Switzer Process Instrument | Chennai | A | | | | Up to 40kg/cm2 & not for Compound Switch and except 900 series |
| | | II | | | | Trafag | Gurgaon | A | | | | Up to 40kg/cm2 & not for Compound Switch |
| | | II | | | | Switzer Process Instrument | Ghaziabad | A | | | | Up to 40kg/cm2 & not for Compound Switch |
| | | III | | | | Delta control | UK | A | | | | |
| | | I | | | | Gauges Bourdon (GIC) | Panvel | A | | | | Up to 40kg/cm2 & not for Compound Switch |
| | | I | | | | ASHCROFT | Gandhinagar | A | | | | |
| | | * | | | | Wika | Pune | DR | | | | |
| | | III | | | | Gergeion | France | A | | | | |
| | | III | | | | United Electric | USA | A | | | | M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements. |
| | | * | | | | SMC | Japan | DR | | | | |
| | | * | | | | Neodyne | USA | DR | | | | |
| | | * | | | | IMI NORGEN | Noida | DR | | | | |
| | | * | | | | WISE Control | Korea | DR | | | | |
| | | * | | | | Baumer | Vapi | DR | | | | |
| | | * | | | | Vasu Tech | New Delhi | DR | | | | |
| | | III | | | | Bott & Krich | Germany | DR | | | | |
| 31 | Temperature Switch | III | | | | SOR | USA | A | | | Sub QR | |
| | | III | | | | DRESSOR (ASCHROFT) | USA/Germany | A | | | | |
| | | III | | | | ITT BARTON | USA | A | | | | |
| | | III | | | | DELTA CONTROLS | UK | A | | | | |
| | | I | | | | Switzer Process Instrument | Chennai | A | | | | up to 200 Deg. C |
| | | I | | | | Switzer Process Instrument | Ghaziabad | A | | | | up to 200 Deg. C |
| | | II | | | | Trafag | Gurgaon | A | | | | up to 200 Deg. C |
| | | I | | | | ASHCROFT | Gandhinagar | A | | | | |
| | | * | | | | Wika | Pune | DR | | | | |
| | | III | | | | Gergeion | France | A | | | | |
| | | III | | | | United Electric | USA | A | | | | |
| | | * | | | | SMC | Japan | DR | | | | |
| 32 | Flow switch | III | | | | UNIVERSAL FLOW METER | USA | A | | | Sub QR | |
| | | III | | | | Switzer | Chennai | A | | | | |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

8 of 26

C&M Deptt.

Patratu Vidyut Utpadan Nigam Limited * Distt-Ramgarh (Jharkhand)

Thanks,

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR :BHEL Ltd | VENDOR AS APPROVED BY | DATE : 26.04.2017 |
| | CONTRACT NO : CS-9585-001-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVIQ | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | III | | | | Levcon | Kolkatta | A | | | | |
| | | III | | | | DK Instrument | Kolkatta | A | | | | |
| | | III | | | | Khrone Marshal | Pune | A | | | | |
| | | III | | | | Chemtrol | India | DR | | | | |
| | | III | | | | V Automat | NewDelhi | DR | | | | |
| | | III | | | | Gauges Bourdon | Panvel | A | | | | |
| | | III | | | | Magnetrol | Belgium | A | | | | |
| | | III | | | | Ashcroft | Germany | A | | | | |
| | | III | | | | Auxitrol | UK | A | | | | |
| | | III | | | | Mercoid | USA | A | | | | |
| | | III | | | | Delta Control | UK | A | | | | |
| | | III | | | | Merlum | USA | A | | | | |
| | | * | | | | Sumig Corperation | | DR | | | | |
| 33 | Condensing Pots | III | | | | Main Contractor approved Sources | | A | | | | |
| 34 | Electric to Pneumatic converter | III | | | | IMI NORGEN | India | A | | | Sub QR | Make : WATSON SMITH |
| | | III | | | | Fair child | USA | A | | | | |
| | | * | | | | ABB | India | A | | | | Subject to meeting the NTPC specificaion requirement |
| | | * | | | | SMC Pneumatics | Noida | DR | | | | |
| | | * | | | | P & F | Bangalore | DR | | | | |
| | | * | | | | Fairchild India Pvt. Ltd. | Noida | DR | | | | |
| | | * | | | | FESTO | Bangalore | DR | | | | |
| 35 | Conduits lead coated (Flexible) | III | | | | Plica | Ghaziabad | A | | | | Main contractor can propose additional vendor for this item |
| | | III | | | | Bansal laboriories | BHOPAL | A | | | | |
| 36 | Intelligent Battery charger 24V DC & DCDB /BHMS | II | | | | Chabbi Electricals | Jalgaon | A | | | Sub QR | Modules from EMERSON |
| | | II | | | | Eltech | Gurgaon | A | | | | Modules from ELTEK |
| | | II | | | | MasTech | Jalgaon | A | | | | Modules from ELTEK |
| | | II | | | | Emerson | India | A | | | | |
| | | II | | | | MasTech (Selek Modules) | Jalgaon | A | | | | BHMS from M/s USV, Germany |
| | | * | | | | HBL Power Systems | India | DR | | | | |
| | | * | | | | Dubas | India | DR | | | | |
| | | * | | | | Chabbi Electricals (Chabbi Modules) | Jalgaon | DR | | | | |
| | | * | | | | Hitachi Hi Rel | Gandhinagar | DR | | | | |
| | | * | | | | Statcon Power Controls Pvt. Ltd. | Noida | DR | | | | |
| | | * | | | | Chloride Power Systems (caldyne) | India | DR | | | | |
| | | * | | | | Amararaja | Tirupati | DR | | | | |
| | | * | | | | Keltron Power Electronics | Trivendram | DR | | | | |

M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited C & M Deptt. Dist.-Ramgarh (Jharkhand)

A Yadav.

9 of 26

217

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR : BHEL Ltd | VENDOR AS APPROVED BY | DATE : 26.04.2017 |
| | CONTRACT NO : CS-9585-001-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVI-Q | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | * | | | | Universal instrument manufacturing co P Ltd | India | DR | | | | |
| | | * | | | | Hind Rectifier Ltd | India | DR | | | | |
| 37 | Battery Health Monitoring System | III | | | | Emerson | Mumbai | A | | | | |
| | | III | | | | Elsik SGS Pvt Ltd | Gurgaon | A | | | | |
| | | * | | | | B Tech Inc | USA | DR | | | | |
| | | III | | | | Hitachi Hi Rel | Gandhinagar | A | | | | |
| | | * | | | | Hopeckee | Germany | DR | | | | |
| | | * | | | | Hitachi Hi Rel | Gandhinagar | DR | | | | |
| 38 | Battery(Ni-cd) | I | | | | AMCO SAFT | Bangalore | A | | | | |
| | | II | | | | SAFT | France/Sweeden | A | | | | |
| | | I | | | | HBL POWER | Hyderabad | A | | | | |
| | | II | | | | Hopekee | Germany | A | | | | |
| 39 | Socket weld fittings | III | | | | BHEL Approved Sources | | | | | | |
| 40 | Impulse pipe & tubes | II | | | | Mahrashtra Seamless | Raigarh | A | | | | Carbon steel only |
| | | II | | | | Sumitomo/kawasaki/Nippon | Japan | A | | | | |
| | | II | | | | TPS TECHNITUBE | Germany | A | | | | |
| | | II | | | | Veluric & mariesmann | Germany | A | | | | |
| | | II | | | | BHEL | Trichy | A | | | | |
| | | II | | | | Trouvay and Cauvin | France | A | | | | Makes shall be as per approved list (Sr. No. 41) |
| | | II | | | | ISMT | Ahamadnagar | A | | | | Carbon steel only. |
| | | II | | | | Sandvik | | A | | | | For SS only. |
| | | * | | | | TUBACES | Spain | DR | | | | |
| | | * | | | | Salzgitter Mannesmann International | Germany | DR | | | | |
| | | * | | | | Jindal saw | India | DR | | | | |
| | | II | | | | Ratanamani Metal and Tubes | Ahamadabad | A | | | | SS only |
| | | II | | | | Heavy metals and Tubes | Ahamadabad | A | | | | SS and CS only. |
| | | * | | | | Shubhadasmi Metal and Tubes | Mumbai | DR | | | | |
| 41 | Compression fittings | III | | | | Parker | USA | A | | | | |
| | | III | | | | Precision | Mumbai | A | | | | |
| | | III | | | | Asiech | Mumbai | A | | | | |
| | | III | | | | Fluid control Pvt. Ltd. | Pune | A | | | | |
| | | III | | | | HP Valves and fittings | CHENNAI | A | | | | Ferrulesa are to be hardned at Exim Holand for pressure above 9000 psi. |
| | | III | | | | Excel hydro | Mumbai | A | | | | Ferrulesa are to be hardned at Exim Holand for pressure above 9000 psi. |
| | | III | | | | Swagelock | USA | A | | | | |
| | | III | | | | Panam | Mumbai | A | | | | |
| | | III | | | | Maipress | Kolkata | DR | | | | |
| | | * | | | | AURA INC | New Delhi | DR | | | | |
| | | * | | | | Prima Engineers | | DR | | | | |
| | | * | | | | Arya Craft | | DR | | | | |

10 of 26

Bharat Heavy Electricals Limited PS-MKTG Delhi

C&M Deptt.

Patratu Vidyut Utpadan Nigam Limited * Distt-Ramgarh (Jharkhand) *

Afadav.

| NTPC | PROJECT : Patratu STPS Phase-I ( 3 X800MW) | LIST OF ITEMS REQUIRING QP | |
|---|---|---|---|
| | PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | REVISION NO : 00 |
| | CONTRACTOR :BHEL Ltd | VENDOR AS APPROVED BY | DATE : 28.04.2017 |
| | CONTRACT NO : CS-9585-001-2 | | |

| No. | Major Equipment | QP Inspection Category | QP No. 9585-001-QVIQ | QP Submission SCH | QP Approval SCH | Proposed Sub Supplier | Country | SS Approval Status | SS Detail Sub.SCH | SS Approval SCH | Sub QR | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | * | | | | PMT Engineers | Ahemdabad | DR | | | | |
| | | * | | | | Flowtech | Kolkata | DR | | | | |
| | | * | | | | Parker Hannifin India Pvt Ltd | | DR | | | | |
| 42 | Instrument valves | III | | | | BHEL | Trichy | A | | | | |
| | | II | | | | Excel Hydro | Mumbai | A | | | | |
| | | II | | | | Instrumentation Ltd., | Palghat | A | | | | |
| | | III | | | | Swagelok | USA | A | | | | |
| | | III | | | | Parker | USA | A | | | | |
| | | II | | | | HP Valves and fittings | CHENNAI | A | | | | |
| | | II | | | | Fluid control Pvt. Ltd. | Pune | A | | | | |
| | | II | | | | Baldota | Mumbai | A | | | | |
| 43 | Valve manifolds | III | | | | Excel hydro | Mumbai | A | | | | |
| | | III | | | | SCHNEIDER | Germany | A | | | | |
| | | III | | | | Anderson Greenwood | USA | A | | | | |
| | | III | | | | Astech | Mumbai | A | | | | |
| | | III | | | | HP Valves and fittings | CHENNAI | A | | | | |
| | | III | | | | Fluid control Pvt. Ltd. | Pune | A | | | | |
| | | III | | | | Microprecision | Faridabad | A | | | | |
| | | III | | | | Parker | USA | A | | | | |
| | | III | | | | Swagelock | USA | A | | | | |
| | | III | | | | Baldota | Mumbai | A | | | | |
| | | * | | | | Maipress Engg. works | Kolkata | DR | | | | |
| | | * | | | | Flow tech | Kolkata | DR | | | | |
| 44 | Local Instrument Enclosure/Rack | I | | | | Pyrotech | Udaipur | A | | | | |
| | | I | | | | Instrumentation Limited | Kota | A | | | | |
| | | I | | | | Sajas electrical | Trichurapalli | A | | | | |
| | | I | | | | Prammen | Puddukottai | A | | | | |
| | | I | | | | Chemin | Pondicherry | A | | | | |
| | | * | | | | Forbes Marshall | Pune | DR | | | | |
| | | * | | | | Positronica | Vadodara | DR | | | | |
| | | * | | | | Procon | Chennai | DR | | | | |
| 45 | Instrument Cables | I | | | | Paramount | Khushkhera | A | | | | PVC,FRLS type,ROP |
| | | I | | | | Polycab | Daman | A | | | | PVC,FRLS type,ROP |
| | | I | | | | Delton | Faridabad | A | | | | PVC,FRLS type,ROP |
| | | I | | | | KEI | Bhiwadi | A | | | | PVC,FRLS type |
| | | I | | | | Elkay Telelinks | Faridabad | A | | | | PVC,FRLS type |
| | | I | | | | CORDS | Chopanki | A | | | | PVC,FRLS type,ROP |
| | | I | | | | CORDS | Kaharani | A | | | | PVC,FRLS type,ROP |
| | | I | | | | Nicco | Kolkata | A | | | | PVC,FRLS type |
| | | II | | | | TEW & C | USA | A | | | | |
| | | II | | | | Habia cables | Sweeden | A | | | | |
| | | II | | | | Kerpen cables | Germany | A | | | | |
| | | II | | | | Lapp cables | Germany | A | | | | |
| | | II | | | | Thermo electa Bv | Netherland | A | | | | |
| | | I | | | | Universal Cable | Satna | A | | | | PVC,FRLS type |
| | | I | | | | Thermocables | Hyderabad | A | | | | PVC,FRLS type |

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

11.04.26

Adalaj

Patratu ★ Distt-Ramgarh (Jharkhand) ★ C&M Deptt.







219