

**1X800 MW KOTHAGUDEM TPS
(TSGENCO)**

***TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM***

SPECIFICATION NO. : PE-TS-410-555-A001

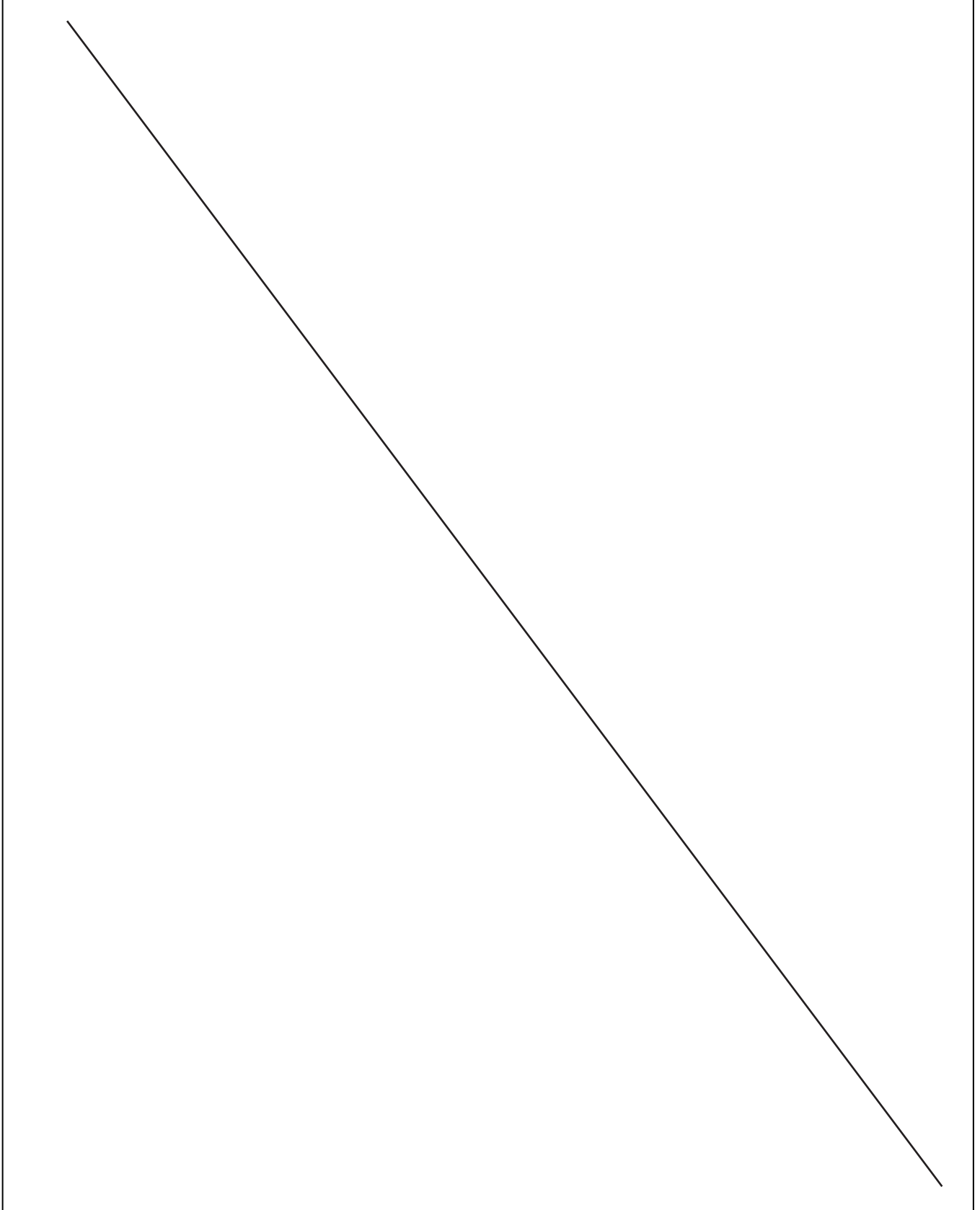


**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA (INDIA)**

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COMPRESSED AIR SYSTEM
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UNIT-12**

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SECTION – A

INTENT OF SPECIFICATION

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1.0 INTENT OF SPECIFICATION

- 1.1 This specification covers the supply of equipment & services as specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, loading, unloading & storage at site, supply of erection materials, consumables, start-up & commissioning spares, maintenance tools & tackles and mandatory spares as required to complete the compressed air system including erection and commissioning, final painting & carrying out performance tests at site for COMPRESSED AIR SYSTEM as mentioned in the different sections of this specification for 1 X 800 MW KOTHAGUDEM TPS.
- 1.2 The bidder 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 responsibility of providing such facilities to complete the supply, erection and commissioning of the Compressed air system.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to 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 herewith.
- 1.4 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.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 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 Vol-III of the specification. In absence of any such clarifications, 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

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by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

In case bidder requires any clarification on technical specification before submission of bid, the same has to be submitted in required format (as per Vol-III-I) within two weeks from date of N.I.T, there after no further clarification shall be entertained and BHEL's interpretation will be binding on the bidder.

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

1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule along with the cost of withdrawal; otherwise, it will be presumed that the bidder's offer is strictly in line with NIT specification.

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

1.10 Unless specified otherwise, all through the specification, the word bidder shall have same meaning as successful bidder / vendor.

1.11 The standard quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan as minimum requirement during manufacturing and testing.

1.12 Other requirements
Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 2 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

Document approval by customer under Approval category or information category shall not absolve the bidder of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the bidder in writing and require written approval. Unless any change in specified requirement has been brought out by the bidder during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case bidder submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to bidder's account and shall not be used as a reason for extension in contract completion.



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SECTION – B

PROJECT INFORMATION

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4.00.00	SOURCE OF COAL
5.00.00	SOURCE OF WATER
6.00.00	ASH DISPOSAL AREA
7.00.00	SALIENT DESIGN DATA

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 **SOURCE OF WATER**

Source of water (total quantity of water is 2192 m³/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 **ASH DISPOSAL AREA**

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 **SALIENT DESIGN DATA**

7.01.00 Meteorological data of site is given below:-

Elevation above MSL : 89 m

Monthly highest temperature : 44.9 °C

Monthly lowest temperature. : 12.9 °C

Rainfall

Average.: 1031 mm

Max. : 100 mm/ hr

Mean Wind speed : 44 m/sec

Relative Humidity

Max : 82%

Min : 35%

Seismic Zone : Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].



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SECTION – C.1

SCOPE OF SUPPLY, TERMINAL POINTS & EXCLUSIONS

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1. SCOPE OF SUPPLY AND SERVICES:

The scope of work under this specification shall be as below.

Items not specifically mentioned but deemed necessary by the Tenderer for making the system completely reliable and efficient shall also be considered as if included.

1.1.1

Total lump sum firm prices for the supply of equipment & services as specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, loading, unloading & storage at site, supply of erection materials, consumables, start-up & commissioning spares, maintenance tools & tackles and mandatory spares as required to complete the compressed air system including erection and commissioning, final painting & carrying out performance tests at site for COMPRESSED AIR SYSTEM as mentioned in the different sections of this specification for 1 X 800 MW KOTHAGUDEM TPS.

1.1.2

Three (3) Nos. Instrument Air Compressors (Oil Free Screw type) each of minimum 30 NM3/Min capacity at 8.5 Kg/cm2 (g) discharge pressure, suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories.

1.1.3

Three (3) Nos. Air Drying Plants Heat of Refrigerant Type of min. 33 NM3/min. capacity connected to above IA compressors with all instruments, control panels and other accessories as specified.

1.1.4

Three (3) Nos. Service Air Compressors (Oil Free Screw type) each of minimum 30 NM3/Min capacity at 8.5 Kg/cm2 (g) (min) discharge pressure, suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories.

1.1.5

Seven (7) Nos. Air Receivers of minimum fifteen (15) Cu.M capacity each with instruments, relief valve, drain connection with automatic trap stations and other accessories as specified.

1.1.6

Bidder to provide necessary pad of dimension 80x80x10 mm for mounting of sensors and key phasor slot of dimension 30x15x3mm for each motor & compressor Driven and Non Driven end in each X & Y direction. Dimension indicated are tentative, shall be finalised during detail engineering.

1.1.7

Three (3) No. online Electronic Dew point meters.

1.1.8

Pipes & fittings for compressed air line, cooling water & drain line including hanger/supports, auxiliary structural members etc. inclusive of all cu-tubing for control air piping, fittings, valves, Counter flanges, bolts, nuts, gaskets etc. at all piping terminals, base plates, support plates, anchor bolts, nuts, sleeves, inserts, lifting lugs, eye bolts etc and other accessories as required - 1 Lot .

1.1.9

All airline valves & cooling water valves – 1 Lot

1.1.10

Instruments including all instruments necessary for performance testing of compressors as well as air drying plants & Compressed air system as a whole – 1 Lot.

1.1.11

Maintenance tools and tackles, start up and commissioning spares, consumables, first fill of lubricants inclusive of packing – 1 Lot

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1.1.12 Any other item not indicated above, but required to complete Compressed Air package as per system requirements. 1.1.13 All HT motors which are not in bidder's scope of supply, bare motors only shall be supplied as free issue by BHEL to successful bidder based on motor inputs furnished by bidder, like motor rating and TS (Torque - Speed) curve. The responsibility for satisfactory operation for combined performance of compressors & motors shall rest with the bidder only as if, the drive motors also have been supplied by the bidder. Couplings, base plate, foundation bolts, any other fittings, etc. as required shall be supplied by the bidder only. BHEL shall supply motors to successful bidder works for shop testing of compressors with job motors. All other motors (mandatory spare) shall be dispatched by BHEL directly to project sites. 2. TERMINAL POINTS : 2.1 Bidder will terminate compressed air piping for common IA header and common SA header downstream of air receiver as per enclosed tender drawing no PE-DG-410-555-SK001 (Pl. refer annexure VI , Vol.-III). 2.2 Cooling water supply will be provided by the purchaser outside the compressor house as per enclosed tender drawing no PE-DG-410-555-SK001. The return hot water shall be terminated by the contractor at the same location (Pl. refer annexure VI, Vol.-III). 3. EXCLUSIONS : 3.1 HT motors for air compressors. 3.2 MCC/Switchgear for power supply to Air Compressors and other drives and panels. 3.3 Civil works like construction of compressor house, foundation of all compressor, air dryer and air receiver, pipe/cable trenches. However, civil works such as opening in wall, grouting of equipment's & structural material and inserts plates for pipes supports etc. are in the bidder's scope of supply. 3.4 Lighting and ventilation of compressor house. 3.5 Monorail hoists/Cranes as necessary for handling of equipment after erection. 3.6 Vibration monitoring system. However, there shall be provision for VMS sensors on DE & NDE bearings of motors and fans/pumps/compressors. Each bearing shall have two vibration sensor, one in X direction and other in Y direction along with key phasor for online vibration monitoring and analysis. 1. SUB-VENDOR ITEMS The tentative make of Sub-vendor items shall be generally as per Annexure-II, Vol.-III enclosed which is subject to customer approval during detail engineering. 2. DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID The drawings and documents to be submitted with the bid shall strictly be as mentioned under Volume III (Annexure-XIII). Any documents other than those indicated in Volume III will not be reviewed and will not form part of contract. 3. DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING Tentative list of drawing / document required during detail engineering is attached in Volume-III (Annexure-V). Any other drawings and documents as required by BHEL / Customer /			

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Consultant shall be furnished by the successful bidder during detail engineering stage for which no commercial implication shall be entertained by BHEL.

4. DRAWINGS DISTRIBUTION SCHEDULE

Vendor needs to submit 12 sets of hard copies of each drawing/document during detail engineering along with editable soft copy of the same. However, exact no. of drawings / documents and submission/distribution procedure for the same shall be intimated to the successful bidder after award of contract and the same shall be complied by the successful bidder without any commercial implication.

5. DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

- 1) Plot plan (Pl. refer annexure VI, Vol.-III)
- 2) P&I Diagram for compressed air system with Refrigerant type air drier (Pl. refer annexure VI, Vol.-III).

The P&I diagrams are indicative and show the minimum requirement to be followed including minimum requirement of instruments. Any other item and instruments required (within the terminal points) to make the system complete in all respect and for satisfactory operation of the system shall also deemed to have been included by the bidder in their scope. The detailed P&I diagrams for compressed air system in line with specification requirement shall be developed by the vendor during detail engineering for customer's approval and without any commercial implication to customer. Bidder to note that the while preparing PIDs after placement of order, successful bidder shall incorporate line numbers Instrument tag nos., KKS Numbering, equipment no, Line Spec, Line MOCs, legend / symbol chart, equipment capacity, relief valve capacity and set pressure, control valve capacity, range, fail position etc. in these drawing and same are subject to the customer approval.

6. Mandatory Spares

General requirement of mandatory spares will be as per the list enclosed under Annexure – IX, Vol.-III. The successful bidder immediately after approval of PID, Layout & equipment/instrument data sheets /GA will prepare detailed list of mandatory spares with regard to their exact quantities, applicability/ non applicability; supply of alternate items against non-applicable items etc. This list will be submitted to customer for getting their approval. The successful bidder will proceed for ordering only after approval of the list.

7. OTHER REQUIREMENTS

- Detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 2 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- The O&M Manual to be submitted by the successful bidder will necessarily address the following:
 - a. Complete System Description along with PIDs, write up on electrical philosophy and safety/process interlocks etc.

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b. Instructions for plant operation

c. Commissioning procedure of the system

d. Chapter on precautions to be taken during:

➤ Operation

➤ Idle time

➤ Long shutdown

e. Chapter on trouble shooting during plant operation covering:

➤ Safely aspects

➤ Do's and do not's

➤ Maintenance schedule

➤ Schedule of lubricants & consumables

f. O & M instruction for all individual equipment which shall invariably contain but not necessarily limited to the following:

➤ Equipment description/interdiction

➤ Data sheet, Equipment GA & Cross Section Drawing

➤ Catalogue of each equipment

➤ DO's & DON'T's

➤ Duty Conditions

➤ Installation & Safety Recommendation

➤ Start-up & shut down procedure

➤ Instructions for testing and adjustment of system parameters

➤ Disassembly & Assembly Instructions giving sequence no. of each component

➤ List of Replacement/ Spare parts along with their drawing and catalogues and procedure for ordering spares.

➤ Reason & Remedy Chart for any problem

➤ Maintenance Schedules- Daily, Weekly, Monthly, Half Yearly and Annual indicating clearly the spares part and man-hour requirement for each stage.

➤ Detailed specification/ Schedule of all the consumables including lubricant oils, greases, chemicals etc. required for the complete system

➤ Commission procedure for equipment.

• Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

• In case vendor submits revised drawing/doc after approval of the corresponding drawing/doc, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

• Bidder to note that during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per dwg/ document distribution schedule. Bidder would be provided access to the DMS for drg/doc

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approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end

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

DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM’s DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.

For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

- Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
- Wherever CIVIL works is excluded from the bidder’s scope, successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor”.
- If any deviation is there then same to be indicated separately under the heading “Schedule of Technical Deviation” enclosed as per Volume III (annexure-XI) of the Technical Specification along with Cost of Withdrawal. In case nothing is mentioned under the column Cost of withdrawal then during bid evaluation no price implication will be admissible for withdrawal of deviations. Bidders shall also note that the deviation in any other form except above is not acceptable (i.e. in data sheet or other Annexure or elsewhere in the offer) and same shall not be considered for review/evaluation purpose/comments and it would be assumed that the system/material/equipment has been offered strictly in line with specifications/requirements.
-

8. Bidder to note the following information :

8.1.1 Bidders to indicate offered model in their offer and to submit backup document (e.g. performance test, etc.) matching FAD calculation along with the catalogue of the offered model to justify selection.

8.1.2 Bidder to confirm that there is no deviation from the technical specification and furnish signed Compliance cum Confirmation Certificate enclosed under Volume-III of the Technical Specification.

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8.1.3 Bidder to submit minimum 10 set of hard prints of drawing & docs. for approval. Also, 10 set of approved documents & O&M Manual to be submitted along with 5 CD's after completion of engg.

8.1.4 Bidder to note that the isolation valves for unit air receiver shall be of 150 NB.

9. ADDITIONAL POINTS TO BE NOTED BY BIDDER

12.1 Compressed Air system shall be offered as turnkey basis meeting specification requirements.

12.2 Basis of design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drg. and documents like data sheet/Technical particulars etc. are subject to Customer & BHEL approval during detail engineering stage.

12.3 All drawings and documents shall be computer based.

12.4 All commissioning spares & consumables for trouble free operation shall be provided, with minimum to what specified elsewhere in the specification.

12.5 Bidder to clearly note that the instruments, valves etc as shown in the P&I Diagram is the bare minimum and any additional instruments/valves required to complete the system in terms of safety, trouble free operation of equipment's & system as a whole and isolation of individual equipment for maintenance, then same shall be supplied by the bidder without any commercial implication to BHEL.

12.6 Grouting of equipment's, like Air receiver, Air dryer & foundation bolts etc. are in the scope of the bidder.

12.7 Performance test for compressors shall be carried out at shops with job motor only.

12.8 All the instruments as required for performance testing shall be arrange by bidder. Instrument for testing shall be calibrated from government certified labs & this is in the bidder scope. Bidder to ensure validity of such reports before the performance tests.

12.9 Compressor and air dryer shall be designed for cooling water (passivated DM water) with inlet temp of thermal 36 deg C (max.) & mechanical 50 deg C with terminal pressure 06 kg/sqcm (g) and rise in temp shall be limited to 10 deg C and pressure drop across Compressed Air System within terminal point shall be limited to 8 mwc. However, Compressors and dryers coolers shall be designed to withstand 12 kg/cm² i.e., shutoff head of BHEL DM cooling water pumps.

12.10 Bidder to note that the cooling water pipe size shall be decided considering cooling water requirement for Compressed air system & additional cooling water requirement of 25 M3/hr. for MRS compressors. Also, bidder to provide 200 NB isolation valves (globe type) both for cooling water supply & cooling water return line. Further, bidder to note that terminal point for these tapping shall be provided 5 m from compressor house at end closer to pipe rack/pedestal.

12.11 Height of Air receivers shall be limited to 5M for all air receivers except unit air receiver. The height of unit air receiver shall be limited to 4M.

12.12 Bidder to note that RTD/BTD of HT motor of air compressor shall be terminated to temperature scanner (one for each compressor to be provided by bidder) mounted on compressor itself. Signals of RTD/BTD shall be communicated to micro-processor based compressor panel through this temperature scanner (by bidder).Interlocks and protection for RTD/BTD of compressor motor has to be provided from compressor panel itself (By bidder).



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SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)



1X800 MW KOTHAGUDEM TPS
COMPRESSED AIR SYSTEM

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1. INTENT

- 1.1 The purpose of this document is to bring out clarity with regard to the following:
- a) System description and Basic operation & Control Philosophy
 - b) Major technical requirements of various items covered under this package
 - c) Layout requirement
- 1.2 The compressed air system will be designed to meet the requirements of contract technical specification (as a minimum) and for safe & trouble free operation of the system.

2. GENERAL DESCRIPTION

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

3. DESIGN CRITERIA

3.1 SYSTEM DESIGN CRITERIA

Compressed air system includes the following:

Three (3) nos. (2W + 1S) Instrument air (IA) and three (3) nos. (2W + 1S) service air (SA) compressors for each unit including drives, suction filter, intercoolers, after coolers, moisture separators, step up gearbox, silencer and other accessories.

Three (3) nos. (2W + 1S) air-drying plants (ADP) for each unit each suitable for connecting to individual instrument air compressor. Air Drying Plant shall be of Refrigerant type. Dew point of air after ADP shall be suitable for instruments air. Air-drying plant capacity to match air compressor capacity shall be provided.

Intake air filters.

Six (6) nos. air receiver of 15 M3 (min.) capacity, i.e., one no. for each compressor near compressor house. One number of unit Air Receiver of capacity 15m3 located in TG building. The final size of the receivers shall be as per the calculation indicated below.

All interconnecting piping, valves, fittings, supports/hangers, complete drive unit, with protecting guards, device for adjustment, control panel, etc. shall be supplied with each compressor.

Controls & interlocks.

All instruments including the electronic on line dew point meter with suitable sampling connection and isolation valve at the common outlet of the Air Drying Plants.

Crane of 8T capacity. The heaviest part to be lifted is compressor motor of approx. 3.0 ton.

3.2 EQUIPMENT DESIGN CRITERIA

AIR COMPRESSORS

The capacity of instrument air compressor shall be 30 NM³/min (Refer Compressor capacity calculation in Annexure-II). Delivery pressure will be 8.5 Kg/cm² (g) at outlet of IA compressor & 8.0 Kg/cm² (g) at ADP outlet. Each



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compressor will be designed to deliver the nominal capacity at the required delivery pressure.

The capacity of Plant Air Compressor shall be 30 NM³/min. Delivery pressure will be 8.5 Kg/cm² (g) at outlet of SA compressor.

Air compressors will be multi stage oil free, screw type.

The compressor's capacity will be designed for 45⁰ C DBT and 82% RH at atmospheric pressure at site & at MSL of 89.0m.

Testing of compressor will be as per ISO: 1217 & ISO 5167.

Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.

Noise level shall not exceed 85 dB under free field condition when measured at a distance of 1.5 meter above the floor. The discharge blow off silencer and intake silencers shall be designed to meet the above noise limitation level. A background correction factor of +/- 8 dBA shall be applicable while testing of compressors at site/manufacturer's works.

Vibration limit shall be as per API 619, Table-1.

The motor rating (at the design ambient temperature specified for the electric drive in e-PCT/TS/K/02/2014-15/V-A/SEC-II page 107 of the specification) shall be at least 110% of the power required at design condition of compressors (HT Motors) and shall not be less than the power required at any other ambient conditions.

at least 110% of the power required at design condition of compressors (HT Motors) and shall not be less than the power required at any other ambient conditions.

Notch shall be provided in the HT motor for the air compressors to accommodate key phasor probes for vibration monitoring.

Motors for compressors may be imported as per manufacturer's standard. However, performance testing and inspection of the compressors with job motors would be done as per approved QP at the bidders works in India and manufacturer's test certificate shall be furnished.

Compressor and air dryer shall be designed for cooling water from DMCW system. Quantity of cooling water for cooling of air compressors & air dryers to be considered 160 m³/hr. (min.) for all working drives. Pressure drop across the cooling water circuit to be considered as 6 to 8 MWC. The max temp of hot water from compressor shall be 10 deg. C higher cooling water inlet temp.

For intermittent requirement diversity factor is taken for capacity calculation. However, under no circumstance diversity factor less than 0.4 is considered.

The materials of various components for air compressors shall conform to the applicable BIS / BS / ASTM/ DIN standard or any other reputed standards.

- i) Compressor chamber: Cast iron coated with corrosion resistant material.
- ii) Rotors: Forged carbon steel coated with corrosion resistant material
- iii) Timing Gear: Low Alloy Steel.
- iv) Inlet throttle valve & Housing: Aluminium
- v) Shaft / shaft seals: High alloy steel / Stainless Steel.
- vi) Safety valves: Brass / Bronze / Gun metal / SS



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- vii) Water separator: Cast Iron
- viii) Non-return valves: Stainless steel spring loaded type.
- ix) Blow off valve: Stainless steel.
- x) Unloading Cylinder header: Aluminium
- xi) Tube of Blow off cooler / oil cooler: SS / Cupro-Nickel / Copper
- xii) Outer casing of coolers: Carbon Steel
- xiii) Gear box: Cast Iron
- xiv) Gears: Alloy Steel.

MOC for Compressor components within compressor skid shall be as per OEM practice, since air end of compressors are imported by all compressor suppliers.

INTAKE FILTER

Heavy duty dry type suction air filters will be provided at the compressor inlet to prevent dust and dirt from entering the cylinders. The filtering efficiency shall be 99.9% up to particle size of 1 micron. Sound suppressing characteristics will be considered in the filter design. Max. pr. drop across filter at design flow rate in new condition shall be limited to 250mmWC.

AIR DRYING PLANT

Air-drying plant shall be of Refrigerant type. Capacity of each ADP shall be 33 NM³/min (i.e. 1.1 times the rated capacity of instrument air compressor).

Quality of outlet air from ADP shall be in accordance to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air" as follows:

- a) Dew point at outlet of the air drying plant will be minus (-) **20° C** at atmospheric pressure.
- b) The quality of air at the outlet of air drier shall be class – 1 as per ISO 8573.

Material of Construction (MOC) of Refrigerant dryer shall be as per reputed manufacturer standard.

Moisture load & temperature for designing ADP as applicable shall be submitted during detail engineering. For calculating moisture load, relative humidity and dry bulb temperature at ADP inlet shall be taken as 95% & 34°C respectively.

The pressure dew point of the refrigerant type air drier shall be maintained at 3 Deg.C.

Dew point meter shall have 4-20 mA output, which shall be connected to DCS.

AIR RECEIVER

The air receivers will be vertical cylindrical with torispherical ends and with supporting legs for resting on their foundation.

Design Pressure for the air receiver shall be 10.0 kg/cm² (g) and 50 deg C respectively. The hydraulic test pressure shall be 15 Kg/cm² (g).

Receivers shall be designed in accordance with IS: 2825 or section VIII, Division 1 of ASME Code or equivalent.



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The material of construction of shell, dished ends, flanges etc. of the air receivers shall be as per IS-2002/SA 516 Gr70/ equivalent. The corrosion allowance shall be 3.0mm.

The air receiver drain connection shall be provided with automatic drain valve for automatic removal of drain consisting of valve, strainer, double isolation & bypass valve. The set pressure of the relief valve shall be atleast 10% above the working pressure.

Air receiver shall be provided with nozzles, air release vents, safety valve, pressure gauge, temperature gauge, minimum 450 mm dia. manhole for inspection.

The capacity of air receivers shall be calculated as per the formula given below:

$$Var = [(T \times C \times P_A) / (P_{Max} - P_{Min})] \times E$$

Where

Var = Volume of each air receiver (M3)

V_1 = Free air delivery capacity of each Air compressor for IA system or free air delivery capacity of each SA compressor for SA system, M3.

T = Bleed down time in minutes, shall be taken as 2 min.

P_A = Atmospheric pressure (absolute) – kg/sq.cm

P_{MAX} = Maximum system pressure in Kg/Sq.cm absolute, shall be taken as 110 percent of rated compressor delivery pressure.

P_{MIN} = Minimum system pressure in Kg/Sq.cm absolute, shall be taken as 6.5 Kg/Sq.cm absolute.

E = 1.15, considering 15 percent minimum margin to account for peak requirements.

NOTE: The minimum capacity of each air receiver shall be 15 m3 (Nominal).

PIPING, FITTINGS & VALVES (WITHIN COMPRESSOR HOUSE)

PIPING and FITTING

All interconnecting compressed air piping shall be of Stainless steel as per ASTM-A312 GR.304. Size – as per schedule 40S. ANSI-B36.19 up to 50 mm NB and as per schedule 10S. ANSI – B36.19 for sizes equal to & greater than 65 mm NB. Fittings shall be as per Stainless steel as per ASTM A-182 F304.

All cooling water piping will be IS-1239 (Heavy grade) upto 150 NB. IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm. Fittings shall be as per ASTM A-234 Gr. WPB for sizing including 65 mm NB and above. ASTM A105 for sizes upto 50 mm NB.

Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60 deg. C. The insulating material shall be glass or mineral wool as per IS-3690/IS-3677/equivalent with chicken wirenet and 22 gauge aluminium cladding.



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The pipe joints will be screwed coupling type for sizes up to 50 NB and above 50 NB the same will be flanged.

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

VALVES (For Detail MOC, Please refer ANNEXURE-II of e-PCT-TS-K-02-2014-15-Vol IIIE-Sec-5, Page no. 73)

a) Compressed Air Services:

All airline valves shall be ball valve type. For compressed air application, valve material shall be of stainless steel. Valves shall be as per BS-5351.

Construction: Forged body up to 50mm NB and Cast body above that.

Body & Bonnet/ cover: A351 CF8M for cast body, A182 F304 for forged body.

Trim / Disc. : ASTM-A-182 F304 for Gate, Globe, Check valves and 351CF 8M for Ball valves.

Seating surface: For Ball valves PTFE seats and seals.

b) Water Service:

For cooling water lines application, valve material shall be of carbon steel.

Construction: Forged body up to 50mm NB and Cast body above that.

Body & Bonnet/ cover: ASTM-A-216 Gr. WCB for cast body & ASTM-A-105 for forged body.

Trim / Disc.: 13% Cr Steel as per ASTM-A-182 Gr. F6 heat treated and hardened (min 250 HB) for cast body and ASTM-A-105 Hard faced with Stellite (min 350 HB) for forged body.

Seating surface: 13% Cr. Steel as per ASTM-A-182 Gr. F6.

Auto drain trap for each air receiver shall be provided.

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

4. LAYOUT CONSIDERATIONS

Air compressors will be located indoor in a separate compressor room and EOT crane (under slung crane) with pendant control arrangement will be provided so that the heaviest component can be handled during maintenance.

The air receivers will be located outdoors adjacent to the compressor room. Other receiver necessary maintenance access will be provided in the layout.

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

General arrangement drawing for the Compressor House is being attached herewith this document (Annexure-III). Bidder shall confirm along with their offer as the space considered for the Compressor House is sufficient.

5. OPERATION, CONTROL & INSTRUMENTATION

The necessary instrumentation and control has been provided for safe and trouble free operation of compressed air system.

Individual compressor control shall be through microprocessor based control system as per manufacturer's standard.



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Depending upon operational requirement each compressor can be selected and operated in following mode:

- Local Mode: Individual compressor is operated from Local Integral Control System.
- Remote Mode: Individual compressor is operated (start / stop) through DDCMIS OWS.

All the process inputs (digital or analog), other than specific to compressors are taken directly to DDCMIS. Detail of process input shall be furnished in a separate document control & operation philosophy of Compressed Air system.

The connectivity of Integral compressor control system with DDCMIS shall be provided through Hardwired / Soft link depending upon manufacturer's product standard.

Control, Protection & interlocking system for individual compressors shall be achieved through skid mounted proprietary microprocessor based controllers with Graphic User Interface (GUI) with LCD screen based display unit, control switches and other operational keys. These individual controllers shall be hooked-up to Plant DDCMIS. Air Dryer logics shall directly be implemented in DDCMIS.

The standby compressor can also be started depending on the running hours of running compressors. The Logic for same can be envisaged in DCS considering the running hours.

Redundant microcontroller shall be provided for IA & SA compressors.

The connectivity of integral air compressor control system to DCS can be both software /hardware. But in totality all the signal which are connected to Microcontroller shall also be transmitted to DCS, so as to have complete information DCS in CCR.This transfer can be soft or hard or both as decided in engineering meeting. The Start-Up logic and the group logic shall be envisaged in the common DDCMIS located in the main control room.

6. POWER SUPPLY ARRANGEMENT

The power supply (rated voltage, frequency, phase) of the equipment's will be 3.3 KV/ 415 V +/- 10%, 3ph, 50 Hz +3% to -5%.

7. SITE DEMONSTRATION TESTS

At site:

1. Parallel operations of air compressors.
2. Capacity & dew point of air at the outlet of air drying plants of instrument air compressors.
3. Pressure drop across the air drying plants of air compressors.

For inspection at stop separate Quality Assurance Plans for compressors, driers and receivers shall be submitted during detail engineering.

SECTION-I

**TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM**

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SECTION-I

TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification is intended to cover the Design, Engineering, Manufacture, Fabrication, Assembly, Inspection, Testing at Manufacture's works, Packing, Transportation, Delivery, Receipt, Unloading, Storage and handling at site, supervision of Erection, Testing, Commissioning and Field Acceptance/ Performance Guarantee test of compressed air plant consisting of air compressors, receivers and air drier units with all associated accessories and auxiliaries as specified herein after and as required for safe trouble free operation and maintenance for 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana.

1.02.00 It is not intended to specify completely herein, all details of design and construction of equipments. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the vendor's guarantee in a manner acceptable to the purchaser, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work of material which in his judgment is not in full accordance therewith.

1.03.00 The compressed air system shall be comprised of SA & IA systems required for the following areas:

- i) Turbine Generator (TG) and Auxiliaries.
- ii) Steam Generator (SG) and Auxiliaries.
- iii) Water Treatment area.
- iv) Various pump house area
- v) Coal Handling Plant
- vi) Laboratory
- vii) Plant I & C area

2.00.00 GENERAL INFORMATION

2.01.01 The compressed air plant (Compressors and Air Dryers) shall be located in Air Compressor and DG Building. The air receivers shall be located outdoor. All equipments, electricals, instruments to be supplied under this specification

shall be suitable for their respective location. For technical requirements of electrical equipment and accessories relevant sections of the Electrical Specification, Volume-V shall be referred.

2.01.02 Three (3) service air compressors (2W+1S) and three (3) instrument air receiver compressors (2W+1S) of capacity sufficient to meet the requirement of 1x800 MW unit or 25 Nm³/min (minimum), whichever is higher at pressure 8.5 kg/cm² (g) will be used to cater the service and instrument air requirement respectively.

2.01.03 Air drying plant of capacity and number equal to that of each instrument air compressor shall be installed in order to supply moisture free instrument air for the power plant.

2.01.04 Instrument and Service Air Receiver of number equal to that of each instrument and service air compressor respectively shall be provided to store instrument and service air.

2.01.05 All the piping works including all accessories.

3.00.00 **SYSTEM DESCRIPTION**

3.01.00 The Compressed Air System shall meet the requirement of Instrument Air for the control of various pneumatically operated instruments and the Service Air for general plant services for 1x800 MW unit.

3.02.00 To meet the requirement of instrument air and service air, Six (6) nos. of multi stage rotary screw or centrifugal Air Compressors, three (3) compressors (two working and one standby) each for instrument air and service air respectively shall be provided.

3.03.00 Three (3) Nos. of Air drying plants (two working and one standby) of Refrigerant type non-cycle version or desiccant air dryer with continuous and fully automatic operation shall be provided to ensure dry moisture free Instrument quality air. The schematic arrangement of Compressed Air System has been shown in Drawing No.: 13A06-DWG-M-001S.

3.04.00 Compressors, after coolers and intercoolers shall be of water cooled type and shall utilize Passivated Demineralised water (DMCW) for cooling purposes from DMCW system.

The compressors and coolers shall also be connected with ACW system for cooling at the time of commissioning and during emergency.

4.00.00 **CODES AND STANDARDS**

4.01.00 The equipments to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations as applicable, including all its latest amendments subsequent to the year of publication as mentioned below :

4.01.01	IS-2825/1969	: Code for unfired pressure vessels.
4.01.02	IS-4503/1967	: Shell and Tube Type Heat Exchanger
4.01.03	IS-5456/1985	: Code of Practice for testing of positive displacement type air compressors and exhausters.
4.01.04	IS-5727/1981	: Glossary of terms relating to compressors and exhausters.
4.01.05	IS-1239 Part-1/1990	: Mild Steel tubes, tubulars and other wrought steel pipes.
	IS-1239 Part-2/1992	: Mild steel tubes, tubulars and other wrought steel fittings.
4.01.06	IS-6206/1985	: Guide for selection, installation and maintenance of air compressors/plants with operating pressure up to 10 bars.
4.01.07	ANSI-B16.5 (1988)	: Steel Pipes Flanges and Fittings.
4.01.08	IS-7938/1976	: Air Receivers for Compressed Air Installations.
4.01.09	IS-10431 Part-I/1983	: Measurement of Air Flow of Compressor and Exhausters by nozzles.
4.01.10	ASME PTC-9	: Performance Test Codes for Displacement Compressors, Vacuum Pumps and Blowers.
4.01.11	BS-5169/1975	: Fusion Welded Steel Air Receiver.
4.01.12	IS-11989	: Specification air dryer.
4.01.13	ISO-7183	: Compressed Air Dryers - Specification and Testing
	ISO-7183 (Part-II)	: Compressed Air Dryers - Performance rating
4.01.14	API 619	: Rotary Type Positive Displacement Compressors
4.02.00	In case of any contradiction with the aforesaid standards and the stipulations as per this Section and Attachments/Annexures of this section, the stipulations of this Section and its Annexures shall prevail. In case of any contradiction between this Section and Attachments/Annexures, stipulations of Attachments/Annexures shall prevail.	

5.00.00 **SPECIFIC DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS**

5.01.00 The Compressed Air System shall ensure a reliable supply of adequate quantity and quality of oil free dry air on continuous and intermittent basis for the 1 x 800 MW Unit. It consists of two sub systems namely,

- a) Instrument Air (IA) for Instrumentation and Control purposes for the station.
- b) Service Air (SA) for some boiler equipment, general house cleaning and other miscellaneous usage.

5.02.00 The normal pressure of Instrument Air supply at the outlet of Air Dryer shall be 8.0 Kg/Sq.cm (g). Corresponding to the normal pressure at the outlet of dryer, the rated discharge pressure of IA compressor shall be worked out by the Bidder, allowing for pressure drops in system piping, equipment and all other accessories. The rated discharge pressure of IA compressor shall be computed as per guidelines specified above or 8.5 Kg/sq.cm (g) at the outlet of aftercooler, whichever is higher. Each Service Air compressor shall be designed to deliver service air at a rated discharge pressure equal to the rated discharge pressure of each Instrument Air Compressor.

The maximum expected pressure in the system shall be computed by considering 20% overpressure over and above the rated discharge pressure of each air compressor as computed above.

5.03.00 The total Instrument Air requirements for 1 x 800 MW Unit shall be assessed by the following guideline:

$$Z = (A+B+C+D+E+F) \times [1 + (mw+ml)/100] \text{ Where,}$$

Z = Total Instrument Air requirement of 1 x 800 MW unit.

A = Instrument Air requirement for SG & auxiliaries.

B = Instrument Air requirement for TG & auxiliaries.

C = Instrument Air requirement for Water and effluent treatment Plant.

D = Instrument Air requirement for Ash Handling Plant.

E = Instrument Air requirement for Laboratory.

F = Plant C&I requirement.

mw = Wear & tear margin = 10%

ml = Leakage margin = 10%

The free air delivery capacity of each Instrument Air Compressor shall be equal to the one-half of the value Z as obtained or 25 NM³/Min., whichever is higher.

The total Service Air Requirement for 1 x 800 MW Unit shall be assessed by considering the following guideline:

$Y = (G+H+J+K+L+M) \times [1 + (mw+ml)/100]$ Where,

Y = Total service air requirement for 1x800 MW unit.

G = Service Air requirement for SG & auxiliaries.

H = Service Air requirement for TG & auxiliaries.

J = Service Air requirement for Coal Handling Plant.

K = Service Air requirement for Ash handling Plant.

L = Service Air requirement for Various Pump Houses.

M = Service Air requirement for Water and Effluent treatment Plant.

mw = Wear & tear margin = 10%

ml = Leakage margin = 10%

Each Service Air Compressor shall have free air delivery capacity identical to that of each IA compressor but in no case less than the one-half of the value Y as computed above.

- 5.04.00 Compressed air system shall comprise of one (1) IA group and one (1) SA group of compressors. The capacity of each air compressor shall be as per clause No. 5.03.00.
- 5.05.00 IA group shall consist of 3x50% (i.e Two (2) working and one (1) standby) compressors with necessary intercoolers, after coolers, piping, valves, instruments and other accessories with built-in control panel and supplemented by 3x50% Air Drying plant. There shall be one (1) Air Receiver for each IA compressor.
- 5.06.00 SA group shall consist of 3x50% (i.e Two (2) working and one (1) standby) compressors for each unit with necessary intercoolers, after coolers, piping, valves, instruments and other accessories with built-in control panel. There shall be one (1) Air Receiver for each SA compressor.
- 5.07.00 Suitable interconnections shall be kept between SA and IA headers before Air Dryers for each unit with normally closed motorized isolation valves and non-return valve connected in such a way to allow only service air in instrument air header in case of emergency.

- 5.08.00 Equipment operating on Instrument Air and Service Air System shall be designed for a pressure range of 5.5 Kg/cm² (g) to 120% of rated discharge pressure of each air compressor, as computed in accordance with clause no. 5.02.00 above.
- 5.09.00 The delivered compressed air shall not contain any trace of oil, grease or any other impurities. Size of particles in the delivered air shall not exceed 1 Microns.
- 5.10.00 Compressed air system equipment requiring DMCW cooling water shall be capable of operation at design capacity with cooling water inlet temperature subject to a maximum of 36°C in DMCW system. The above equipment shall also be capable to withstand a pressure not less than the shut off head of each DMCW pump.
- 5.11.00 The temperature of air at outlet from after cooler shall not exceed 6°C above the cooling water inlet temperature.
- 5.12.00 Air Compressors shall be identical and shall be designed for continuous operation with high efficiency to satisfy the performance requirements as specified in Annexure-A enclosed with this section.
- 5.13.00 The power rating of the driver shall be selected such that a minimum margin as per the specification of electric motors, is available over the power required to deliver rated capacity against rated discharge pressure. When the driver is not directly coupled to the compressor, due account should be made for losses in power transmission, in addition to the above margin.
- 5.14.00 As more than one (1) compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, Keeping noise level within permissible limits for a number of compressors working simultaneously.
- 5.15.00 Each Air Receiver shall be so sized that even in the event of total stoppage of air inflow to the same, the pressure in the Air Receiver shall not fall below 6.5 kg/cm² absolute within two (2) minutes of such stoppage, while maintaining an out flow of air at a rate equal to the rated capacity of a single compressor, during the aforesaid period. In no case, the size of each Air Receiver shall be less than that arrived from IS 7938.

The capacity of each Air Receiver shall be determined in accordance with the following guidelines:

$$V_{AR} = \frac{T \times C \times P_A}{P_{MAX} - P_{MIN}} \times E, \text{ where}$$

V_{AR} = Volume of each Air Receiver in M³.

T = Bleed down time in minutes, shall be taken as 2 minutes

(minimum)

- P_A = Atmospheric pressure, shall be taken as 1 Kg/Sq.cm (absolute).
- P_{MAX} = Maximum system pressure in Kg/Sq.cm absolute, shall be taken as 110 percent of rated compressor delivery pressure.
- P_{MIN} = Minimum system pressure in Kg/Sq.cm absolute, shall be taken as 6.5 Kg/Sq.cm absolute.
- C = Free air delivery capacity of each Air compressor for IA system or free air delivery capacity of each SA compressor for SA system, M^3 .
- E = 1.15, considering 15 percent minimum margin to account for peak requirements.

The water filled volume of each Air Receiver shall be calculated in accordance with the guidelines specified above.

- 5.16.00 The drying capacity of each Air Drying Plant (ADP) shall be provided to match the corresponding capacity of each IA compressor.
- 5.17.00 The air drying plants receiving compressed air saturated with moisture shall be capable of operating continuously to provide reliable moisture free compressed air. Dew point of the outlet air measured at the stated operating pressure shall be as mentioned in Annexure-B or lower throughout the operation. For calculating moisture load, relative humidity and dry bulb temperature at ADP inlet shall be taken as 95% & 34°C respectively.
- 5.18.00 The drying process shall employ Refrigerant type air drying unit to remove moisture from air. The air drying plant shall be considered to remove the moisture and dry air to following quality:
- a) Dew point at atmospheric pressure (-) 20 degree.
 - b) Oil content 0.01 ppm (maximum tolerable) or oil free.
 - c) Dust – Practically dust free but maximum particle size 1 micron.
- Air quality after air drying plant shall be in accordance with above stipulations or as per ISA – S7.3 (Instrument society of America) quality standards for instrument air, whichever is stringent.
- 5.19.00 Driers shall be suitable for part load operation while maintaining the outlet air dew point as specified above. Necessary instruments and controls shall be provided to ensure that the specified dew point is maintained irrespective of input variations.
- 5.20.00 The contractor shall assume full responsibility in the operation of the air drying plant as a whole.
- 5.21.00 For the air drying capacity and all other relevant details pertaining to Air

Drying Plant, Annexure-B shall be referred to.

6.00.00 SCOPE OF SUPPLY AND WORKS

6.01.00 Scope of Supply

The detailed scope of supply under this section shall be as below and as indicated in relevant tender drawings. Items not specifically mentioned but deemed necessary to make the system completely reliable and efficient shall also be included.

6.01.01 3x50% IA compressors and 3x50%, SA compressors for 1x800 MW unit. There shall be one (1) Air Receiver for each IA compressor and one (1) Air receiver for each SA compressor.

Each Air Compressor shall be complete with Intake Air filter cum Silencer, Intercooler, after cooler, Moisture Separator, interconnecting piping, valves, drive motors, instruments and all other accessories.

6.01.02 Skid mounted redundant proprietary microprocessor based controllers will be provided with individual compressors. These individual controllers shall be hooked upto plant DDCMIS RTU. Air dryer logics shall be implemented in DDCMIS RTU.

6.01.03 All Cooling water piping, control air and interconnecting air piping, valves, supports and hangers, instruments as indicated in tender drawings and as required for smooth, reliable and efficient functioning of the system.

6.01.04 One (1) no. air drying plant for each IA compressor shall be provided by the Bidder. Each air drying plant shall be complete with the following accessories:

- a) Air inlet strainer.
- b) Air to air heat exchanger (pre-cooler).
- c) Air to refrigerant heat exchanger (evaporator).
- d) One (1) moisture separator with auto drain trap.
- e) Refrigerant condensing unit complete with one (1) hermitically sealed compressor, one (1) compressor drive motor, one (1) water cooled condenser, refrigerant circuit access connection, refrigerant distributor, high and low pressure cut-out switches, interconnecting pipes, valves, fittings as required, liquid and suction line, one (1) filter dryer, one (1) sight glass with moisture indicator, safety valves or any other pressure relief devices.
- f) One (1) automatic expansion valve in refrigerant line.
- g) All inter-connecting/integral piping, valves trap stations with by-pass valves at drains, fittings, flanges, gaskets, etc.

- h) Instrument and controls.
- i) Interconnecting wiring.
- j) One (1) dew point indicator.
- 6.01.05 Supporting structures, base plates, support plates, foundation/ anchor bolts, nuts, sleeves, inserts, lifting lugs, eye bolts, etc. as needed for efficient installation and handling of equipment.
- 6.01.06 All interconnecting piping, instrument air and service air distribution piping, valves, supports and hangers, drains, instruments etc. as indicated in the tender drawing nos. 13A06-DWG-M-001S, 13A06-DWG-M-001L and 13A06-DWG-M-001M.
- 7.00.00 **DESIGN AND CONSTRUCTION**
- 7.01.00 The Compressors shall be designed to deliver the nominal capacity at the required delivery pressure as mentioned in Annexure-A of this section.
- 7.02.00 The design shall be such as to ensure trouble free operation with least vibration and noise. Suitable acoustical treatment will be provided to ensure the noise level within permissible limits as specified in Vol-IIA. Different parts of the compressor and accessories shall be arranged neatly in a compact manner. Due consideration shall be given for easy accessibility and maintenance of the compressors.
- 7.03.00 The compressors shall be non lubricated, oil free, horizontal, multi-stage water cooled, electric motor driven screw type, heavy duty and rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.
- 7.04.00 Unless inconsistent with this section, equipment from the standard range of manufacture of the Bidder shall be preferred.
- 7.05.00 Compressor components shall be interchangeable as far as possible. Material of construction shall be suitable for the service.
- 7.06.00 Design capacity, outlet pressure and the material of construction for various parts of the compressor and accessories shall be as specified in Annexure-A enclosed with this section.
- 7.07.00 **Compressor casing, rotor and shaft**
- 7.07.01 Compression chamber wall thickness shall be such that to withstand maximum design pressure.
- 7.07.02 During maintenance of compressor suitable arrangement for cleaning of the cooling water jackets shall be provided.
- 7.07.03 Dynamically balanced, one-piece Rotor construction with a symmetric profile

to keep leakage loss to a minimum and ensure high efficiency.

- 7.07.04 Rotor shaft mounted, highly precise timing gears shall be designed to counter the axial forces incurred in compression.
- 7.07.05 The rotor and shaft shall be of single piece construction, made of forged steel with suitable corrosion resistant coated material to minimize leakage and wear (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron Construction with corrosion resistant material and with integral jacket cooling.
- 7.07.06 The shaft sealing and retainers shall be free for radial self-adjustment on the rotor shafts.
- 7.07.07 The seal rings and retainers shall be of stainless steel construction. The seals shall prevent air and oil leakage along the shaft. Air vented from second stage discharge end seals shall provide buffer air to the other seals to prevent migration of oil towards the compression chamber under all operating conditions.
- 7.07.08 The gaskets shall be of asbestos free material.
- 7.07.09 Use of Oil lubricated anti friction type bearings to be at least 8000 running hours.
- 7.08.00 **Lubrication System**
- 7.08.01 The compressor package shall include a lubricant management system which shall lubricate the bearings and seal. By the design, the compressor chamber (screw rotor housing) is totally separated from bearing / gear chamber.
- 7.08.02 The lubricant pump shall be shaft driven. An auxiliary motor driven pump shall be provided if required by the manufacturer to supply pre-start and shut down system. All lube oil pumps shall be of rotary positive displacement type, having stainless steel rotors and steel casing. The pump discharge system will be protected by a relief valve.
- 7.08.03 The heat exchanger for lube oil cooler shall be water cooled. The heat exchanger shall be located within the enclosed compressor skid.
- 7.08.04 The fouling factor shall be considered as per the recommendation of TEMA.
- 7.08.05 The lube oil cooler shall be designed for a heat duty corresponding to the peak power demand of the compressors.
- 7.08.06 The cooler shall be designed in accordance with the requirement of IS-2825.
- 7.08.07 Due consideration for the differential expansion of shell and tube shall be given in the design of the coolers.
- 7.09.00 **Gear Box**

- 7.09.01 Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position. Gears shall have a rating of AGMA-12 or equivalent.
- 7.10.00 **Inter Cooler, After Cooler and Moisture Separator**
- 7.10.01 Inter-cooler shall be located between the low and high-pressure stages, if required, to reduce overall power consumption. Design performance shall be in accordance with Manufacturer's Standard and wall thickness of tubes and expansion joints shall ensure maximum trouble-free service for long period.
- 7.10.02 Design of intercooler and after cooler shall be such as to keep the Cooling Water pressure drop within limits and complete leak tight condition for long period of service time.
- 7.10.03 After-cooler at each compressor discharge shall be water cooled and supplied by the Bidder. It shall be located after compressor discharge to bring the outlet temperature of the compressed air within 6°C, of the cooling water inlet temperature. The moisture separator to be provided on after cooler air outlet shall have suitable internal baffling for removal of moisture and oil. Necessary safety valves shall be provided on inter coolers and after coolers.
- 7.10.04 Inter-cooler, After-cooler and Moisture Separator shall be provided with Auto trap stations including strainer, bypass and double isolating valves for the traps. A level gauge glass with isolating cock shall be provided near the bottom of moisture separator. Automatic traps shall be of reputed make and shall be of float type suitable for intended services. Y-strainer of 20 mesh screen of stainless steel shall be placed before each trap.
- 7.10.05 The water cooled after coolers and intercoolers shall be shell and tube type. The intercooler shall have air in shell side and water in tube side to add surge volume for reducing air pulsation before the second stage.
- 7.10.06 The shell, tubes, tube sheets and expansion joints with tube sheets particularly at flange portion etc. of the heat exchangers shall be designed to withstand the maximum working pressures encountered. Necessary allowance for corrosion shall be provided.
- 7.10.07 The tubenest shall be removable type to facilitate cleaning and maintenance.
- 7.10.08 Intercoolers/After coolers shall be provided with supports, which are designed to avoid undue stress or deflection in support or body of the equipment.
- 7.10.09 Due consideration for the differential expansion of shell and tube shall be given in the design of coolers.
- 7.10.10 Necessary drain and vent nozzles shall be provided for intercooler and after cooler.
- 7.11.00 **Air Receiver**

- 7.11.01 Air receiver(s) shall be in accordance with IS-2825 or ASME Sections-VIII Div.I and IS-7938.
- 7.11.02 The design pressure, capacity and other parameters shall be as specified in Annexure-A of this section.
- 7.11.03 The air receiver shall be vertical self-supporting cylindrical vessel with torispherical dished ends and with supporting stand for resting on the Civil foundation in accordance with Annexure-A enclosed with this section.
- 7.11.04 Receivers shall be of welded construction with minimum number of joints. Longitudinal seams in adjacent sections of shell shall not be in the same line.
- 7.11.05 All welding shall be performed in accordance with relevant codes. Filler material that will deposit weld metal with a composition and structure as near as that of the material being welded shall be used. The electrodes shall be dried in oven immediately before use to ensure freedom from porosity.
- 7.11.06 Receivers shall be provided with required number of nozzles, the orientations of which shall be subject to approval by the Purchaser. At least two gasketed inspection holes shall be provided for receivers up to 600 mm diameter. For larger diameter manhole of minimum 450 mm diameter shall be provided.
- All openings shall be placed as far as possible from welded seams and in no instance shall pierce the seam.
- 7.11.07 Receivers shall be provided with one or more safety relief valves of proper capacity so that the maximum working pressure of the system is not exceeded under any circumstance. Unless otherwise mentioned, each receiver shall be provided with at least one pressure gauge and one temperature gauge of proper range and required number of pressure switches for compressor control purposes.
- 7.11.08 Each air receiver drain connection shall be provided with automatic no air loss type drain valve for automatic removal of drain consisting of valve, strainer, double isolation and bypass valves.
- Each Air Receiver should have air release vents at the top to facilitate statutory hydraulic tests as per IS-7938.
- 7.11.09 Receiver shall be heat-treated in accordance with BS-5169.
- 7.12.00 **Intake Air Filter and Silencer**
- 7.12.01 Filters with multiple elements and quick removal type for easy cleaning to be provided at suction of each air compressor and shall also be of heavy-duty dry type. Oil bath type shall not be acceptable for non-lubricated compressors.
- 7.12.02 The filters shall be complete with integral silencers and all other accessories. The filtering elements shall be easily removable for cleaning or for

replacement.

- 7.12.03 The filters shall be designed for an efficiency of not less than 95% for particles 1 microns and larger.
- 7.12.04 The silencer shall be of very high efficiency type to adequately dampen the operating noise as per the requirements in Volume-IIA.
- 7.12.05 Pulsation dampener of approved design shall be provided on the compressor suction and discharge manifold.
- 7.12.06 If filter after receiver is specified in Attachments/Annexures, the same shall be provided to remove the bulk of moisture and other contaminants entrained in the air stream.

7.13.00 Drive Unit

- 7.13.01 The compressors shall be driven by constant speed squirrel cage induction motor unless otherwise specified in Annexure-A of this section. For determining the output rating of driver, general guidelines as indicated in Cl. no. 5.13.00 of this section and Volume V of this specification shall be followed.
- 7.13.02 The driver shall be connected to the compressor either directly or through gear box as per Annexure-A of this section.
- 7.13.03 For other types of connection between drive unit and compressor, suitable flexible coupling shall be provided.
- 7.13.04 Necessary guard shall cover all exposed moving parts.
- 7.13.05 Motor speed torque curve shall match with that of the compressor for trouble free start up.
- 7.13.06 Motor shall be capable for three (3) equally spreaded starts per hour. Two start in quick succession from cold condition and one restart from hot condition.

7.14.00 Moisture Separator

Moisture separator shall be of high efficiency design & no air loss type and provided with vent nozzle and auto drain trap system.

7.15.00 Air Dryer, Precooler, Evaporator and Refrigerant condenser

- 7.15.01 Air-drying plant shall be of Refrigerant type.
- 7.15.02 Air dryer shall be located Indoor.
- 7.15.03 Complete ADP equipments shall be preferably mounted on a skid.

- 7.15.04 Precooler, Evaporator and Refrigerant condenser shall be of shell and tube type construction.
- 7.15.05 Precooler shall use dry air and wet air as shell and tube side fluids respectively.
- 7.15.06 Evaporator shall use refrigerant as shell side fluid and air as tube side fluid media.
- 7.15.07 Refrigerant condenser shall be water cooled with refrigerant as shell side and cooling water as tube side fluid.
- 7.15.08 Design shall conform to TEMA (USA) – Class-C.
- 7.15.09 Heat Exchanger elements like shell, tube and tube sheet shall be adequately designed to withstand the design pressure.
- 7.15.10 Drain and vent nozzles and safety valves, as necessary, shall be provided for the precooler, evaporator and refrigerant condenser.
- 7.16.00 **Refrigerant Compressor**
- 7.16.01 The compressor for the refrigerated type air dryer shall be hermetically sealed, reciprocating, medium speed, single acting type designed with ecofriendly refrigerant R-134A or equivalent.
- 7.16.02 The reciprocating compressor shall be complete with cylinder liner, pistons, crank shaft, connecting rod, bearings, suction and discharge valves, crank case heater, proper lubrication system etc. (as applicable).
- 7.16.03 The compressor shall be complete with all parts and accessories commended by the manufacturer to run it efficiently and satisfactorily.
- 7.16.04 The safety devices against high pressure of refrigerant, low pressure of refrigerant shall be provided.
- 7.16.05 The horse power for the compressor motor shall be sized with margin as per specification of electric motors over maximum rated power required for the unit including the drive loss.
- 7.16.06 The compressor assembly shall be adequately designed for minimum vibration and noise disturbances.
- 7.16.00 Expansion valve shall be of thermostatic type.
- 7.16.00 All the components of the Air Drying plant including the strainers, filter, interconnecting piping, valves, fittings, control panels, etc. shall be mounted on a common fabricated steel base frame to form a self contained unit.
- 7.17.00 **Pressure Vessels**

- 7.17.01 All pressure vessels shall be designed as per IS : 2825 or approved equal.
- 7.17.02 The vessels shall be of self supporting construction. All welding materials and procedures shall be as per IS: 2825 or approved equal.
- 7.17.03 Each vessel shall be provided with suitable air-tight manhole and other connections as required.
- 7.17.04 Relief valves of adequate capacity shall be provided for each vessel. Relief valves shall be provided with hand lever. The valves shall be of stainless steel construction.
- 7.17.05 Internal surfaces of all the vessels shall be suitably protected against corrosion and rusting. Corrosion allowance of 2.5 mm shall also be provided on shell and dished end thickness.
- 7.17.06 Draining trap station complete with Auto drain trap, isolation and by-pass valves and Y-strainer shall be provided for the moisture separator.
- 7.18.00 **Solenoid Valves and Multiway Valves**
- 7.18.01 The solenoid valve shall be of approved make. The solenoid valves shall have heavy duty, double impregnated tropicalised coils (Single or double solenoid as required) and shall be suitable for the operating temperature and for operation continuously energised, in a tropical climate.
- 7.18.02 The solenoid valves shall be of bronze body with stainless steel trim. The coil shall be of continuous duty and of epoxy moulded type, Class-F. The enclosure shall conform to NEMA-4X standard.
- 7.19.00 **Drives and Mounting**
- 7.19.01 All relevant details pertaining to drives shall generally comply with the stipulations laid in Volume V.
- 7.19.02 All the components of the Air Drying plant including the strainers, filter, interconnecting piping, valves, fittings, control panels, etc. shall be mounted on a common fabricated steel base frame to form a self contained unit.
- 7.20.00 **Interconnecting Piping, Valves and Fittings**
- 7.20.01 Pipelines shall be selected as per IS-6206/equivalent standard. Piping in airlines and cooling water lines up to 40 NB shall be socket welded and 50 NB and above shall be butt-welded and flanged type.
- All interconnected air piping and cooling water piping etc., as indicated in tender drawings shall be furnished by the Contractor, complete with valves, fittings, pipe supports as necessary. The piping shall be as per the Codes/Standards specified in Annexure-A enclosed with this section.
- 7.20.02 The air discharge piping shall be full size of compressor outlet or larger, short and direct with minimum number of fittings. Only long radius elbows shall be

used where bends are unavoidable. The velocity of compressed air in pipe shall be limited as per pipe size 50 NB below 20 to 30 m/sec. & 50 NB above 25 to 40 m/sec.

Any pocket in compressed air and interconnecting air piping shall be provided with drain connection complete with automatic trap station.

Long runs of vertical piping at compressor discharge shall not be acceptable.

The layout shall be such as to prevent resonance. Provision of thermal expansion of hot pipes shall be made.

All pipe connections with equipment shall be flanged type. All pressure gauges/switches shall be complete with root valves and all temperature elements shall be mounted in a proper thermowell.

All instruments, safety valves etc. as shown in tender drawings shall be furnished on the piping.

- 7.20.03 For water cooled compressors, cooling water shall normally be piped through the intercooler and after cooler in parallel. From the intercooler, the water shall be taken to cylinder jackets. A solenoid valve shall be provided on the water inlet line for interlocked starting of compressors. Where provision for automatic water flow regulation by thermostatic valve has been made, a suitable bypass arrangement to the valve shall be made so that flow to the cylinder is ensured under all circumstances.

The velocity in water pipes shall be limited to 2.0 Metres/Sec.

Sight flow indicators shall be provided on water discharge from each cylinder, intercooler and after cooler.

- 7.20.04 Valves to be supplied for compressed air service and DMCCW service shall be as per Annexure-A.

- 7.20.05 All traps shall be float operated. All traps shall be of auto drain type to drain out moisture at regular intervals. The body and cover shall be of cast iron/solid steel construction and internals shall be of SS. Isolating valves shall be of stainless steel.

- 7.20.06 All strainers shall be Y-type with suitable blow-off plugs. The body material shall be cast iron. The screen shall be of stainless steel with 40 mesh openings.

- 7.20.07 Complete piping system shall be provided with adequate supporting arrangement to avoid undue forces and moments at the equipment terminals and vibration.

- 7.20.08 All other pipes and equipment conveying hot air shall be properly insulated to limit outside surface temperature to 60°. The insulating material shall be glass or mineral wool as per IS-3690/IS-3677/equivalent with chicken wirenet and 22 gauge aluminium cladding.

7.21.00 **Dew Point Indicator**

Dew point indicator shall be digital type for spot measurement of dew point of air. The specification of the meter shall be as follows:

- a) Range : (-) 30 °C to (+) 20 °C
- b) Accuracy : ± 0.1 °C

Dew point monitoring facility shall also be provided in local Control Panel as well as in unit DCS operator work station.

7.22.00 **Automatic Drain Valve**

- i) Type : No air loss, electronically controlled level, controlled version.
- ii) Operation : Continuous
- iii) Air flow (free air delivery) : By Bidder
- iv) Air pressure : 8.5 bar g
- v) Ambient temperature (max.) : 50 Deg.C
- vi) Maximum pressure : 16 bar (g)
- vii) Drain connection : 1 inch from back side
- viii) Power supply : 230 V/single phase/50 Hz

8.00.00 **INSTRUMENTATION & CONTROL**

Refer to VOLUME VI.

9.00.00 **INSPECTION AND TESTING**

9.01.00 The Contractor shall carry out the following specific tests and inspections to ensure that the equipment furnished shall conform to the requirements of this section and in accordance with relevant codes and standards.

9.02.00 Material identification of compression chambers, rotor, rotor shaft, suction and delivery valves constituting the compressors and all parts of intercoolers, aftercoolers, moisture separators, air receivers, strainers, filters, all interconnecting air and water piping with valves and all other parts and accessories that could not spelt out in this clause.

9.03.00 Hydrostatic testing of compressor, intercoolers, aftercoolers, moisture separators, air receivers, strainers, filters, all interconnecting air and water

pipings with valves and all other applicable pressure parts that could not be spelt out in this clause. Hydrostatic testing shall be carried out at 150% of the design pressure for at least one (1) hour, unless contradicted by the relevant test code.

- 9.04.00 Specific tests to be carried out for each compressor
- 9.04.01 Non-destructive testing of rotors, rotor shaft and all other applicable parts.
- 9.04.02 Type test/Routine tests for all the air compressors as per IS-5456. All performance tests for compressors shall be carried out with actual motor being furnished. Routine tests shall include the following tests and measurements :
- a) Capacity (Free Air delivery)
 - b) Speed
 - c) Specific power consumption
 - d) Volumetric and overall efficiency of machine
 - e) Test of loading and unloading mechanism
 - f) Any other test deemed necessary for the system
- 9.04.03 Dynamic balancing of all rotating components and assembly of each air compressor including all drive motors in the compressed air system.
- 9.04.04 Tests for capacity, pressure drop and efficiency of each Intake Air Filter with silencer shall be as Manufacturer's standard. These tests shall be conducted along with performance testing of each compressor.
- 9.05.00 Dew Point tests to be carried out on each Air Drying Plant.
- 9.06.00 Spot radiography of all weld parts shall be tested for all pressure parts and vessels.
- 9.07.00 Testing of all drive motors and control panels in the compressed air system shall be as outlined under Volume V of this specification.
- 9.08.00 Any other test deemed necessary for the system.

10.00.00 PERFORMANCE GUARANTEES

10.01.00 Performance Guarantee

- 10.01.01 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. All compressor units and accessories shall be guaranteed to operate without pulsation, noise or vibration while operating in isolation as well as in parallel with other compressor.
- 10.01.02 All compressor unit and accessories shall be guaranteed for capacity, pressure and power consumption for specified capacity and pressure either in isolation or during parallel operation.
- 10.01.03 Drying plant capacity shall be guaranteed for the dew point of minus (-) 20 Deg. C at atm pressure at the dryer outlet as specified in data specification sheet.
- 10.02.00 **Deficient Performance**
- 10.02.01 Performance test and guarantee test shall be carried out in line with the stipulations laid down in data sheets for compressed air system and all defects shall be satisfactorily rectified without affecting overall time schedule of the project. No extra cost shall be charged to the owner for such rectification. After rectification, retesting shall be done by the contractor without any extra cost to the owner till satisfactory performance is achieved.
- 11.00.00 **DRAWINGS/DOCUMENTS, DATA & INFORMATION TO BE FURNISHED BY THE BIDDER ALONG WITH THE TECHNICAL OFFER**
- 11.01.00 The Bidder shall furnish along with his proposal following specific drawings/ documents/data as asked for in this section.
- 11.01.01 P&I Diagram.
- 11.01.02 Preliminary Layout drawing.
- 11.01.03 Calculations establishing the rated pressure, FAD capacity of compressors and characteristic curves showing efficiency against capacity, capacity of Air Receivers and ADPs.
- 12.00.00 **DRAWINGS/DOCUMENT, DATA, AND MANUALS TO BE FURNISHED AFTER AWARD OF CONTRACT**
- 12.01.00 Final version of all drawings/data/informations asked for in clause 10.00.00 above.
- 12.02.00 Certified dimensioned general arrangement drawing; detailed cross-sectional drawing with parts list and details of material; piping layout drawings for Compressed Air System.
- 12.03.00 Foundation drawings with dead load, operating load and other design data.
- 12.04.00 Functional logic diagram showing operational philosophy, inter lock and

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- protection for the compressed air system.
- 12.05.00 Complete design calculations for heat exchangers, moisture separator, air receiver, etc.
- 12.06.00 Local panel layout and complete electrical schematic drawings for instrumentation and control.
- 12.07.00 Detailed list of Instruments showing make, size, range, tag nos. etc.
- 12.08.00 Bill of material indicating tag nos., type, sizes, working pressure, material of construction, quantity etc. of the following :
- a) Pipe
 - b) Valves and
 - c) Fittings
- 12.09.00 Detailed test reports, certified performance curves as required for all the applicable equipment in Compressed Air System.
- 12.10.00 Quality assurance plan, datasheet, flow diagram and final layout drawing.

ANNEXURE-A

SCREW TYPE AIR COMPRESSOR AND AUXILIARIES

A. Performance Data

Free Air Delivery	: Bidder to compute and indicate as per guidelines specified in this section.
Discharge Pressure	: As per clause no. 5.02.00
Noise level near compressors	: 85 dBA (Maximum)
Vibration limit	: As per API 619, Table-1
Guaranteed Power consumption at motor input terminals at rated condition	: Bidder to indicate

B. Construction Features

Location	: Indoor
No. of compressors	: Three (3) Nos. of IA compressors + Three (3) Nos. of SA compressors.
Type	: Oil-free, dry screw type, water cooled, horizontal, two (2) stage, rotary screw compressors or centrifugal type.
Service	: Instrument Air and Service Air
Duty	: Continuous
Type of Drive	: Electric Motor
Design ambient for drive	: 50°C
Number of starts per hour	: 3 (equally spreaded)
Type of transmission	: Gear
Antivibration arrangement required	: Yes
Maximum temperature for any step during the cycle	: Bidder to indicate.
Type of control	: Dual i.e., both load-unload and auto start/stop
Type of Annunciation	: Audio-visual

Flange standard : ANSI B-16.5/equivalent

C. Materials of Construction

Compressor chamber : Cast iron coated with corrosion resistant material

Rotors : Forged carbon steel coated with corrosion resistant material

Bearing : As per manufacturing standard.
(Antifriction Bearing)

Timing Gear : Low alloy steel

Base Plate : MS

Inlet throttle valve & housing : Aluminium

Shaft seals : High Alloy Steel

Safety valves : Brass

Water separator : Cast Iron

Blow off valve : Stainless Steel

Unloading Cylinder header : Aluminium

Tube of oil cooler : SS-304

Outer casing of coolers : Carbon Steel

Gear Box : Cast Iron GGG 40 (DIN 1693)

Gears : Alloy Steel

D. Supply of Accessories and Service

Intake air filters with silencers : Yes

Intercoolers : Yes

Aftercoolers with moisture separators : Yes

All instruments as specified, as shown in tender drawing and as required for safe and trouble- free operation of the system : Yes

Coupling guards : Yes

Air receivers	: Yes
Base plates	: Yes
Foundation bolts, nuts, sleeves, inserts etc.	: Yes
All interconnecting air and cooling water piping, complete with valves, fittings as shown in relevant tender drawings and as required for reliable and smooth operation of the system	: Yes
Eye bolts, lifting tackle, tools, etc.	: Yes
Control panels complete with all accessories	: Yes
Instrument gauge panels complete with all accessories	: Yes

E. DM Cooling Water Data

Quality	: Passivated DM Water
Design inlet temperature	: 36°C (max)
Maximum Allowable temp. rise	: 6°C
Design pressure	: Bidder to indicate. Shall not be less than the shut off head of DMCCW pump.
Normal inlet pressure	: Bidder to indicate. Shall be equal to the rated TDH of DMCCW pump
Maximum pressure drop allowable between inlet and outlet points	: 6.0 to 8.0 MWC

F. Testing And Inspection

Material Testing and identification	: Required
Dye Penetration test	: Yes
Type of performance test to be conducted	: Routine test/Type test as per Clause No. 9.04.02 of this section.
Bend Test as per BS 5169	: Yes
Field performance test	: Yes
MPI and UT tests	: Yes

Spot Radiography for all : Yes
circumferential and longitudinal butt
joints

All other specific tests as specified in : Yes
Clause No. 9.00.00 of this section

G. Drive Motor

Drive motor for compressor shall
comply with the requirements of
Clause No. 7.13.00 of this section and
Volume V of this Specification.

H. Compressor Accessories

a) Intake Air Filter

Numbers required : One (1) no. with each compressor

Location : Indoor/At the suction of each air
compressor

Type : Dry type

Silencer : Yes

Air flow rate : To suit compressor rating

Particle removing efficiency : 99.9% up to particle size of 1 Micron

Maximum allowable pressure drop : 150 mm WG
at stated air flow rate in new
condition of filter (viscosity of air at
normal ambient temperature)

Test requirement : No separate test. Compressor
performance testing will include the filters
in test set up. Capacity, pressure drop
and efficiency shall be measured.

b) Air Receiver

Numbers required : One (1) for each IA compressor + (1) for
each SA compressor.

Installation : Outdoor

Type : Vertical cylindrical with torispherical
dished ends.

Design pressure	: 10 Kg/Sq.cm(g)
Hydraulic test Pressure	: 15 Kg/Sq cm(g)
Design code	: IS-2825/IS-7938/ Approved equal
Capacity of each air receiver	: Bidder to compute in accordance with clause no. 5.15.00 of this section. However the water filled volume shall not be less than 10 M ³ under any circumstances.
Material of construction of shell	: IS-2002
Material of construction of dished ends	: IS-2002
Material of construction of flanges	: IS-2002
Supply of Accessories & Services	:
Flanges with nuts, bolts and gaskets	: Yes
Pressure gauge with snubber	: Yes
Pressure switch	: Yes
Temperature indicator	: Yes
Relief valve	: Yes, set pressure shall be atleast 10% above working pressure.
Trap station	: Yes
Level gauge	: Yes
Vent valve/plug	: Yes
Supporting stand with necessary foundation bolts, nuts, sleeves, etc	: Yes
Eye bolts, lifting tackle etc.	: Yes
Painting	
i) External	: Two coats of red-oxide primer and two finish coats of synthetic enamel paints.
ii) Internal	: Shop painted as per manufacturer's

standard.

Inspection and Testing

Material testing and identification : Yes

Bend test as per BS-5169 : Yes

Spot radiography of circumferential and longitudinal butt welds : Yes

Field performance test : Yes

D.P. test where radiography cannot be done : Yes

Hydraulic Test : Yes

Other specific tests as specified in Clause No. 9.00.00 of this specification : Yes

c) **Intercooler, Aftercooler, Moisture Separator, Piping, Valves etc. :**

i) Aftercooler :

Installation : Indoor

Type : Shell and Tube

Relief Valve : Yes

Moisture Separator : Yes

Trap Station : Yes

Temperature Indicator : Yes

Temperature Switch : Yes

Level Gauge : Yes

ii) Intercooler :

Installation : Indoor

Type : Shell and Tube

Relief Valve : Yes

- | | | |
|-----------------------|---|-----|
| Trap Station | : | Yes |
| Pressure Gauge | : | Yes |
| Temperature Indicator | : | Yes |
| Temperature Switch | : | Yes |
| Moisture Separator | : | Yes |
- iii) Supply of Accessories and Services :
- | | | |
|--|---|-----|
| Supporting stands with bolts, nuts and gaskets | : | Yes |
| Eye bolts, lifting tackle etc with tools and tackle | : | Yes |
| Flanged connections for supply and return of cooling water | : | Yes |
- iv) Material of Construction :
- | | | |
|------------|---|--------------------------------------|
| Tube | : | Stainless steel with in star profile |
| Shell | : | Mild Steel |
| Tube Sheet | : | IS 2002 Gr 2A |
| Baffles | : | IS 2062 |
| Flanges | : | IS 2062 |
- v) Cooling Water Data :
- Same as mentioned earlier
- vi) Piping, Valves and Fittings for Compressed Air System :
- | | | |
|--|---|--|
| Pipes for cooling water line | : | IS-1239 (Heavy grade) upto 150 NB.
IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm. |
| Pipes for compressed air line & interconnecting air line | : | Stainless steel as per ASTM-A312 GR.304. Size – as per schedule 40S. ANSI-B36.19 up to 50 mm NB and as per schedule 10S. ANSI – B36.19 for sizes equal to & greater than 65 mm NB. |
- Fittings

Fittings for cooling water line	:	ASTM A-234 Gr. WPB for sizing including 65 mm NB and above.
		ASTM A105 for sizes upto 50 mm NB.
Fittings for compressed air piping & interconnecting air piping	:	Stainless steel as per ASTM A-182 F304
Valves for air line	:	Stainless Steel
Valves for cooling water line	:	Carbon Steel
vii) Testing and inspection	:	As per clause No. 9.00.00 of this section.

ANNEXURE-B

AIR DRYING PLANT AND AUXILIARIES

A. General Information

Numbers of Air drying Plant	: Three (3) nos. [2W + 1S]
Duty	: Continuous
Operation	: Fully Automatic
Service	: Instrument Air
Version	: Non-Cyclic
Installation	: Indoor
Type of Drying	: Refrigerated or desiccant air dryer
Type of Refrigerant	: R-134 A
Outlet dew point	: Atleast (-) 20 Deg.C at 1 atm pressure.
Annunciation	: Local and remote
Location	: Indoor skid mounted

B. Performance Specification

Air drying capacity	: To suit the compressor capacity (110% of the compressor capacity)
Pressure dew point (constant) at prevailing pressure	: By Bidder
Inlet air pressure	: To suit compressor rating
Air flow (Free Air delivery)	: To suit compressor rating
Inlet air temperature	: Suitable to handle air inlet temperature of 60 Deg.C
Maximum allowable air pressure drop	: 0.5 kg/sq.cm
Design Requirement	: Atleast (-) 20 Deg.C dew point at outlet (at atm. Pressure). Dust laden not more than 1 ppm, oil free

C. Technical Particulars

a) Pre-cooler

- | | | |
|------|------------------------|---|
| i) | Type | : Shell and tube type (Fixed tube bundle type). |
| ii) | Shell side fluid media | : Dry Air |
| iii) | Tube side fluid media | : Wet Air |
| iv) | Design pressure | : Bidder to indicate |
| v) | Code of construction | : TEMA-Class-C |
- b) Evaporator
- | | | |
|------|------------------------|---|
| i) | Type | : Shell and tube type (Fixed tube bundle type). |
| ii) | Shell side fluid media | : Refrigerant |
| iii) | Tube side fluid media | : Air |
| iv) | Design pressure | : Bidder to indicate |
| v) | Code of construction | : TEMA-Class-C |
- c) Refrigerant condenser
- | | | |
|------|------------------------|---|
| i) | Type | : Shell and tube type (Fixed tube bundle type). |
| ii) | Shell side fluid media | : Refrigerant |
| iii) | Tube side fluid media | : Passivated DM Cooling water |
| iv) | Design pressure | : Bidder to indicate |
| v) | Code of construction | : TEMA-Class-C |
- d) Refrigerant Compressor
- | | | |
|------|------------------|--------------------------------------|
| i) | Type | : Hermetically sealed, Reciprocating |
| ii) | RPM | : 1500 |
| iii) | No. of cylinders | : Bidder to indicate |
| iv) | Type of coupling | : By Bidder |
| v) | Refrigerant | : R-134 A |
| vi) | Design standard | : API-618 |

vii) Testing standard : IS-5111

D. Materials Of Construction

Precooler, evaporator, refrigerant
condenser

- a) Tube : Stainless steel
- b) Shell : Seamless pipe or fabricated from steel
plate (ASTM A-285 Gr.C)
- c) End plates : IS-2002 Gr.2A or equivalent.
- d) Tube sheet : IS-2002 Gr.2A or equivalent.

**E. Supply Of Accessories And
Services For Each ADP**

- Strainer : 2 x 100%
- Dew point indicator : Yes
- Instruments as per specification : Yes
and as required for safe and
trouble free operation
- Control panel with accessories : Yes
- Tools and tackle : Yes
- All interconnecting piping : Yes
complete with fittings, valves etc
- Insulation : Yes
- Baseframe, foundation bolts, nuts, : Yes
sleeves etc.
- Vessel internal point : Anti-corrosive
- Shop painting : Yes

F. Testing And Inspection

- Non destructive material test : Yes
- Performance tests at shop and : Yes
site

Spot Radiography of welds parts : All pressure parts and vessels
to be tested

Dye Penetration test : Yes

Hydrostatic Test : Yes

Other Specific Tests : As per clause No. 9.00.00 of this section.

G. Miscellaneous

Air flow variations : 0 to 100%

Auto drain trap : No air loss type

VOLUME : IIIE

SECTION-V

LOW PRESSURE PIPING, VALVES AND SPECIALTIES

1.00.00 GENERAL INFORMATION

This section covers all the low-pressure piping up to 400mm NB size, associated valves and specialties that include but is not limited to the following systems.

- 1.01.00 Service Air System - shall consist of distributions service air to different buildings.
- 1.02.00 Instrument Air System - shall comprise of distribution of instrument quality air to pneumatically operated instruments/ valves/dampers.
- 1.03.00 Demineralised Water Supply system including hot well make-up water piping from condensate storage tank.
- 1.04.00 Demineralised Water closed cycle cooling system.
- 1.05.00 Service water system.
- 1.06.00 Potable water system.
- 1.07.00 Any other low pressure piping as found necessary during detail engineering shall also be included.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out in Volume IIA, the design, manufacture, inspection and testing of the piping, fittings, valves and specialties covered under this specification shall conform, in general, to the standards and codes (latest edition) mentioned below:

- 2.01.01 IS-1239 : Mild steel tubes, tubular and other wrought steel fittings.
[Part-I & II]
- 2.01.02 IS-3589 : Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
- 2.01.03 IS-554 : Dimensions for pipe threads where pressure tight joints are required on the threads.
- 2.01.04 IS-1363 : Hexagonal head bolts, screws and nuts (size range M5 M36)
[Part-I & II]

2.01.05	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm)
2.01.06	IS-3138	:	Hexagon bolts & nuts (M42 to M150)
2.01.07	IS-5312	:	Swing check type reflux (non-return) valves.
2.01.08	IS-2379	:	Colour code for the identification of pipelines.
2.01.09	IS-2016	:	Plain washers
2.01.10	IS-2712	:	Compressed asbestos fibre jointing
2.01.11	ANSI B-16.5	:	Steel pipe flanges and flanged fittings
2.01.12	ANSI B-16.9	:	Wrought steel Butt welding flanged
2.01.13	ANSI B-16.11 : ANSI B-36.10 :		Forged steel fittings, Socket-welding and Threaded. Steel pipes thickness
2.01.14	API-600	:	Steel gate valves
2.01.15	BS-2633	:	Class I Arc welding of ferrite steel pipe work for carrying fluids.
2.01.16	BS-534	:	Specification for steel pipes and specials for water and sewage.
2.01.17	BS-5351	:	Specification for Ball valves.
2.01.18	AWWA-C-504	:	Specification for Butterfly valves.
2.01.19	AWWA-C-208	:	Dimension for fabricated steel water pipe fittings.
2.02.00	Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Purchaser.		
3.00.00	SCOPE OF WORK		
3.01.00	The equipment and materials to be supplied shall include but not be limited to the following:		
	a)	Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc. as required for the piping system under the scope of this section.	
	b)	Matching pipes, matching pieces like reducers/enlargers etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.	
	c)	Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.	

- d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc. complete with the counter flanges and matching connecting pieces as required within the entire low pressure piping system.
- e) Anchors, hangers and supports, etc. as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc.
- f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping should be avoided to the extent possible.
- g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches.
- h) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc. as required for interconnecting piping, valves & fittings.
- i) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

3.02.00 Following general requirements shall however be provided

- a) Instrument Connections including instruments, root valves, sensing lines etc.
- b) Pipe stubs and blanking plates etc. required for chemical cleaning and hydro testing.

For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.03.00 All miscellaneous instruments

4.00.00 **GENERAL DESIGN AND CONSTRUCTION**

4.01.00 **General Considerations**

4.01.01 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.

4.01.02 The piping system shall be complete in every detail and in accordance with the highest standard of workmanship.

- 4.01.03 All design and fabrication shall be in accordance with codes/standards specified.
- 4.01.04 No pipe work shall be run in trenches carrying electrical cables.
- 4.01.05 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.
- 4.01.06 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.
- 4.01.07 Air release and drain branches shall be provided wherever necessary depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.
- 4.01.08 Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80 deg. C or as required by the design of the different piping system, if higher.
- 4.01.09 **Drain Pipe Work**
- a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.
 - b) Unless otherwise stated, all drain piping shall be of 25 mm NB minimum and all vent pipings shall be of 15 mm NB size minimum. For pipes up to 50mm NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10.
 - c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.
- 4.01.10 Specification of pipes used in different services included in the L.P piping section has been detailed in Annexure-I.
- 4.02.00 **Material Specification**
- 4.02.01 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Purchaser depending on the merits of alternative material.
- 4.02.02 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

4.03.00 Fabrication

Except where otherwise specified all piping shall have butt-welded connections with a minimum of flanged joints necessary for maintenance. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.

Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. all welded branches shall be reinforced where needed as per the applicable codes/regulations.

4.03.01 Piping shall be fabricated in the shop in the largest transportable sections to minimize the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.

4.03.02 All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations. A cross section through any bent portion of the pipe shall be true in diameter, within plus or minus 3% of the pipe diameter. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per the relevant code.

4.03.03 For bends in pipes straight piece of pipes shall be bent by the contractor to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided.

4.03.04 The ends of Pipe and welded fittings shall be bevelled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

4.03.05 Cutting and Bevelling

- a) Carbon steel piping - End preparation for butt welding shall be done by machining/flame cutting.
- b) Socket welding - Socket weld and preparation shall be done by saw or machine cutting.

4.04.00 Hangers, Supports, Anchors

Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.

4.04.01 Support spacing shall be as per good engineering practice. However in no case it shall be less than support spacing stipulated in ANSI B31.1.

4.04.02 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

4.04.03 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.

4.04.04 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Bolt holes shall be drilled not burned. Support components may be bolted to concrete using approved concrete anchors.

4.05.00 Valves and Accessories

4.05.01 General Requirements

- a) All valves shall be of approved make and type and shall have cast/forged bodies with covers and glands of approved construction and materials as specified in Annexure-II & III. In general all pumps (other than sump pumps), discharge valves shall be motor operated only. Tank inlet valves shall be motor operated only.
- b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs should be avoided as far as possible.
- c) All valves shall, unless otherwise stated, have the internal diameter same/as the internal diameter of the pipes to be joined.
- d) All valves shall receive tests at manufacturer's or contractor's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Purchaser.
- e) Gate valve and Ball valve have been specified with the intention of achieving isolation and tight shut-off. In full open condition, these valves should offer minimum of resistance to fluid flow.

- f) Globe valves have been specified with the intention of achieving good control of fluid passing. The plug and seat will have therefore suitable profiles for obtaining such controlling action.
- g) Check valves have been specified in order to prevent reverse flow through them.
- h) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.
- i) Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes.
- j) By pass valves shall be provided for larger size valves as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.
- k) All flanged valves and specialties to be supplied under this section shall be provided with two (2) counter flanges, bolts, nuts, washers, gaskets etc.
- l) All valves shall be of approved design and manufacture. Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Purchaser's approval.
- m) All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.
- n) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:
 - i) Hand wheel with embossed open and shut directions.
 - ii) Local position indicator.
 - iii) Motorised operation as specified by Engineer.
- o) Gate valves, in addition shall be provided with following extra features
 - i) Bypass valve for larger valves
 - ii) Draining arrangement
 - iii) Enclosed Gear operators for valves 300 mm size and above for ease in operation.
 - iv) Motorised operation as specified by Engineer.
- p) All gate and globe valves shall be rising stem type.

- q) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.
- r) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.
- s) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.
- t) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.
- u) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.
- v) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.
- w) Plastic or bakelite valve hand wheels will not be accepted.
- x) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.
- y) Wherever practicable heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500 kg. shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.
- z) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.
- aa) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

bb) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.

cc) All sampling and root valves shall be of integral body bonnet type.

4.05.02 For Design Requirements for different valves refer Annexure-II & III.

4.06.00 Safety/Relief Valves

Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.

All safety valves shall be provided with manual lifting lever.

Valves used for air and any other compressive fluid shall be of pop type.

Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.

Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.

The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

4.07.00 Hosepipe and Accessories

4.07.01 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves.

4.07.02 Hose pipes with fittings for Service Water System:

- a) The water hose shall be as per IS-444 (Type-3).
- b) Length of each hose shall be 15 metres.
- c) For each hose, one end shall be fitted with M.S. female coupling with swiveling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swiveling nut of a second hose whereby two hose lengths may be joined.

4.07.03 Hose pipes with fittings for Compressed air System

- a) The compressed air hose shall be as per IS-911 (Type 2).

- b) The length and type of each end shall be similar to as specified in above clause no. (4.07.02) above.

5.00.00 DRAWINGS, DATA, INFORMATION & MANUALS

5.01.00 Drawings, data, Information to be furnished by the Bidder besides those already mentioned in volume : IIA with the offer.

5.01.01 A complete list of all piping and fittings of various sizes with their quantities and details e.g. nominal size, O.D., I.D. (as applicable) thickness, design pressure, design temperature, material of construction/code/standards etc.

5.01.02 A complete list of all valves with their type, quantities & ratings.

5.01.03 Manufacturer's catalogue indicating complete range of available size and rating of pipes & fittings.

5.01.04 Descriptive literature on the manufacturing process and quality control procedures highlighting the manufacturing, fabricating and testing facilities available in the shop.

5.02.00 After Award of Contract

Detail drawings including fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/data pertaining to the hydrostatic and non-destructive test requirements to be submitted progressively.

5.02.01 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, the bill of materials and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

5.02.02 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.

5.02.03 Wiring diagram for all limit switches of motor operated valves.

5.02.04 The loading data required for design of structures shall be furnished well in advance to suit Purchaser's time schedule.

6.00.00 BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING

6.01.00 All fittings like "T" pieces, flanges, reducers etc. shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

6.02.00 Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered

- part of work and is required to carry out such work as per instruction of Owner, which shall include specified heat-treatment procedures, etc. also wherever required.
- 6.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.
- 6.04.00 Suspension for piping, pressure parts, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.
- 6.05.00 All the valves, lifting equipments, actuators, power cylinders, etc., shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and also during pre-commissioning. Even after commissioning, the equipments, if there are problems in the operation, they have to be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work.
- 6.06.00 All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over the end caps shall be put back in tube openings till such time they are welded to other tubes.
- 6.07.00 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even after completion of erection, which shall be carried out by the Bidder without any extra cost to the Purchaser. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.
- 6.08.00 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Contractor shall take prior approval from Engineer. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Engineer.
- 6.9.00
- a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.
 - b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.
 - c) Piping shall be routed above ground unless otherwise specifically indicated/ approved by the Engineer. In such special case, the piping may be arranged in trenches, or buried and properly protected as per AWWA Standards.

- d) Overhead piping shall have a minimum overhead clearance of 4 meters above walkways and working areas and 7 meters above roadways unless otherwise approved by the Engineer.
- e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective drawings or not. The pipelines shall be sloped towards the drain points.

6.10.00 All drips and drains for piping and equipment whether shown in the drawings or not shall terminate on the ground floor up to station drain unless otherwise specified. Leading such drains up to station drainage is also the responsibility of the Contractor.

ANNEXURE-I

SPECIFICATION OF PIPES FOR DIFFERENT SERVICES

	A	B	C	D
Services	1. Clarified Water piping 2. DMCW piping	1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)	1. Demineralised Water, Service and Instrument Piping less than and equal to 50 mm NB	1. Demineralised Water, Service and Instrument air piping for sizes equal to greater than 65 mm NB
1.00.00 Material of Pipe	Carbon Steel IS-1239 Heavy Grade upto 150 mm NB and IS-3589 for sizes above 150 mm with minimum pipe thickness of 6 mm.	Carbon Steel as per IS-1239 Heavy Grade for sizes upto 150 mm NB and IS-3589 for sizes above 150 mm NB with minimum pipe thickness of 6 mm. The pipes shall be galvanized as per IS-4736	Stainless Steel as per ASTM A-312 Gr. 304. Size- as per schedule 40 ANSI B36.10	Stainless steel as per ASTM A-312 Gr. 304. Size-upto 150 mm NB as per schedule 10S, ANSI B-36.10.
2.00.00 Construction	ERW / Seamless	ERW / Seamless	ERW	ERW
3.00.00 Joints	Slip-on Flange and butt weld for size 65 mm NB and above and Socket weld joint for size 50 mm NB and below.	Screwed flange for sizes 65 mm NB and above and screwed socket for size 50 mm NB and below.	Socket welded for size 50 NB and below	Slip-on flange and butt weld joint.
4.00.00 Fittings	Pipe Sizes > = 65 mm NB Pipe Sizes < = 50 mm NB	Pipe Sizes > = 65 mm NB Pipe Sizes < = 50 mm NB		

**Telangana State Power Generation Corporation Ltd.
Kothagudem TPS Stage -VII, Unit #12 (1X800 MW)**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

	A		B		C	D
Services	1. Clarified Water piping 2. DMCW piping	1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)	1. Demineralised Water, Service and Instrument Piping less than and equal to 50 mm NB	1. Demineralised Water, Service and Instrument air piping for sizes equal to greater than 65 mm NB		
4.01.00 Materials	ASTM-A-234 Gr. WPB	ASTM-A-105	ASTM-A-234 Gr. WPB galvanized as per IS-4736	ASTM-A-105 galvanised as per IS-4736	ASTM-A-182 F304	ASTM-A-351-CF8
4.02.00 Construction	Welded/ Seamless	Forged	Welded/ Seamless	Forged	Forged	Welded/Seamless
4.03.00 Standard	ANSI-B-16.9 for fabricated fitting AWWA-C-208	ANSI-B-16.11	ANSI-B-16.9	ANSI-B-16.11	ANSI-B-16.11	MSS-SP-43
4.04.00 End details	Pipe size >=65mm NB Butt welded as per ANSI-B-16.25	Pipe size <=50 mm NB Socket welded as per ANSI-B-16.11	Pipe size >=65 mm NB Screwed Flanged	Sizes <=50 mm Screwed socketed as per ANSI-B-16.11All fittings shall be galvanized.	Socket welded	Slip - on flanges

DEVELOPMENT CONSULTANTS
(e-PCT-TS-K-02-2014-15-Vol III-E-Sec-5)

V.III-E/S-V : 14

**Telangana State Power Generation Corporation Ltd.
Kothagudem TPS Stage -VII, Unit #12 (1X800 MW)**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

A		B		C		D	
Services	1. Clarified Water piping 2. DMCW piping	1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)	1. Demineralised Service and Instrument Piping less than and equal to 50 mm NB	1. Demineralised Water, Service and Instrument Air Piping for sizes equal to greater than 65 mm NB	150lb class, flat face, as per ANSI-B-16.5 complete with nuts, bolts and gaskets.		
	5.00.00 Flanges	150 lb class as per ANSI-B-16.5 complete with nuts, bolts and gaskets	As per ANSI-B-16.5 pressure class 150lbs - galvanised-complete with nuts, bolts and gaskets.	As per ANSI-B-16.5 pressure class 150lb complete with nuts, bolts and gaskets. Material as per class 4.01.00.			
Pipes which fall under IS:1239 shall be hydrostatically tested according to the said code, for others refer Section-V, Vol.: II-A.							

ANNEXURE-II

SERVICES OF VARIOUS CATEGORIES OF VALVES

Valve Classification		Service		
A.	Cast iron body Gate/Globe/Check Valve	i)	Service Water	For sizes 65mm NB and above.
		ii)	Clarified Water	
		iii)	Drinking/ Potable Water	
		iv)	Inhibited Demineralised Water	
B.	Stainless steel body/ Gate/Globe /Check/Ball Valve	i)	For Demineralised water	For all sizes
		ii)	Potable/ Drinking Water	For sizes less than and equal to 50 mm NB
		iii)	Service and Instrument Air	For all sizes. Ball valves to be used in air line.
C.	Steel Body valves	i)	Clarified Water	For sizes less than and equal to 50 mm NB
		ii)	Inhibited Demineralised Water for DMCW system	
D.	Cast Iron body butterfly valve	i)	For Demineralised Water	For butterfly valve specification refer Annexure II, Sec.IV of Vol. IIIE. For DM water line rubber lining/ EPDM/equivalent protection to be provided
		ii)	Raw water	
		iii)	Clarified Water	
		iv)	Filtered Water	
		v)	Inhibited Demineralised Water for DMCW system	

ANNEXURE-III

SPECIFICATION OF VALVES

	A. Cast Iron Body Gate/ Globe/Check Valve	B. Stainless steel Body Gate/Globe/Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valve/ Ball Valve
1.00.00	Valve Classification	SSGC	STGC
2.00.00	Basic Design Code		
	a) Gate	a, b, c) ANSI-B-16.34	i) API 600 for 50mm ii) API 602 for size
	b) Globe		b) BS-1873/ANSI-B-16.34
	c) Check		c) BS-1868/ANSI B16.34
	d) Ball	d) BS-5351	
3.00.00	Pressure Class	To be suitably chosen considering the pressure requirement. Refer Clause No. 4.01.08 in this regard.	
4.00.00	Construction	Cast body and bonnet / cover	Same as Group-B
5.00.00	Material		
5.01.00	Body & Bonnet/ cover	IS 210 Gr. FG 260	ASTM-A-216 Gr. WCB for cast body & ASTM-A-105 for forged body

**Telangana State Power Generation Corporation Ltd.
Kothagudem TPS Stage -VII, Unit #12 (1X800 MW)**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

	A. Cast Iron Body Gate/ Globe/Check Valve	B. Stainless steel Body Gate/Globe/Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valve/ Ball Valve
5.02.00	Trim / Disc.	IS-210 Gr. FG 260	13% Cr Steel as per ASTM-A-182 Gr. F6 heat treated and hardened(min 250 NB) for cast body and ASTM-A-105 Hard faced with Stellite (min 350 HB) for forged body
5.03.00	Seating surface	13% Cr steel as per IS 1570	13% Cr. Steel as per ASTM-A-182 Gr. F6
6.00.00	End Preparation	Socket welded for size equal to and below 50mm NB and flanged with counter flanges for 65mm NB and above.	
7.00.00	Testing		API-598
	a) Gate	i) As per IS - 780 for 50 mm - 300 mm NB ii) IS-2906 for sizes equal to and above 350 mm NB Hydrostatic Test as per MSS-SP-85	As per ANSI B-16.34
	b) Globe	IS-5312/MSS-SP-71	BS-1873 BS--1868
	c) Check		

SECTION-XIII

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
- d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
- e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00** Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.
- 4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**
- 4.01.00** After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.
- All factory finished paints shall be touched up at site as required.
- All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.
- 4.02.00 Surface Preparation**
- 4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.
- 4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.
- 4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.
- 4.03.00 Painting**

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
 - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :

- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
- b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
- c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.

4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :

- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
- b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
- c) Total thickness of primer and paint should not be less than 500 microns.

4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

- e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 INFORMATION/DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

VOLUME

SECTION

REVISION 00

DATE: 03/04/2015

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VOLUME – II B

SECTION – C.3

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)



TITLE:	ELECTRICAL EQUIPMENT SPECIFICATION FOR COMPRESSED AIR SYSTEM 1X800 MW KOTHAGUDEM TPS	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 19/03/2015
		SHEET: 1 OF 1

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C	ELECTRICAL LOAD DATA FORMAT	1
C	DATASHEET-A	1
C	CABLE SCHEDULE FORMAT	1
D	QUALITY PLAN (FOR MOTORS BELOW 55 KW)	2
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**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
(ELECTRICAL PORTION)**

SPECIFICATION NO.
VOLUME II B
SECTION-C
REV 0
PAGE 1 OF 2
DATE 19.03.2015

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

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 Cranes.
- 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 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.



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
(ELECTRICAL PORTION)**

SPECIFICATION NO.
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4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)
- f) Electrical mandatory spares (As per spec.)

NIDHI RAWAT
(Sr. ENGR.)

SUBHASH SINGH
(Sr. MGR)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : COMPRESSED AIR SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1X800 MW KOTHAGUDEM TPS

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	11 kV/ 6.6 KV / 3.3 KV / 415 V Switchgear	BHEL	BHEL	415 V AC, 3 phase, 3 wire supply 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 motors.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor 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. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	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	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system. 100/50 mm cable trays/Conduits/Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	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	Cable glands, lugs & bimetallic strip for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipments supplied by vendor.	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	--
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	--
12	Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : COMPRESSED AIR SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1X800 MW KOTHAGUDEM TPS

15	Any other equipment/material/service required for completeness of system based on the system offered by vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	--
16	a. Input cable schedules (C & I) b. Cable interconnection detail for the above c. Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Cabling layout drawings	BHEL/ Vendor	-	a. In case of Compressor are HT motors, cable tray/trench layout inside compressed air building shall be prepared by BHEL. Vendor to furnish drawing (both in print form as well as AUTOCAD) of compressor room layout clearly indicating all motors, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc. b. In case of Compressor are LT motors, for ensuring cabling requirements are met, vendor shall prepare & submit cable tray/trench & equipment layout (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling for BHEL review & approval.
18	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/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 mismatch due to vendor engineering at later stage, vendor shall supply the junction box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.



TITLE

LV MOTORS

DATA SHEET-A

SPECIFICATION NO.

VOLUME II B

SECTION C

REV NO. 00 DATE 19.03.2015

SHEET 1 OF 1

- | | | | |
|------|--|---|---|
| 1.0 | Design ambient temperature | : | 50 °C |
| 2.0 | Maximum acceptable kW rating of LV motor | : | <175 KW |
| 3.0 | Installation (Indoors/ Outdoors) | : | As required |
| 4.0 | Degree Of Protection | : | IP55 - Outdoor
IP54 – Indoor |
| 5.0 | Details of supply system | | |
| | a) Rated voltage (with variation) | : | 415V $\pm$ 10% |
| | b) Rated frequency (with variation) | : | 50 Hz (Variation: +3% TO –5%) |
| | c) Combined voltage & freq. variation | : | 10% (sum of absolute values) |
| | d) System fault level at rated voltage | : | 25 kA for 1 sec |
| | e) Short time rating for terminal box | : | 25 kA for 0.25 sec |
| | f) LV System grounding | : | Solidly |
| 6.0 | Class of insulation | : | Class 'F', with temp rise limited to class B. |
| 7.0 | Minimum voltage for starting
(As percentage of rated voltage) | : | 85% of rated voltage |
| 8.0 | Power cables data | : | Shall be given during Detailed engg. |
| 9.0 | Earth Conductor Size & Material | : | Shall be given during Detailed engg. |
| 10.0 | Space heater supply (30KW & ABOVE) | : | 240 V, 1 Φ , 50 Hz |
| 11.0 | Rating up to which Single phase motor | : | Acceptable below 0.20 Kw |
| 12.0 | TYPE OF STARTER PROVIDED IN MCC | : | DOL |
| 13.0 | Locked rotor current | | |
| | a) Limit as percentage of FLC | : | 600% |
| | b) Permissible tolerance, if any | : | $\pm$ 20% |
| 14.0 | Additional tests | : | As per QP |
| 15.0 | Flame-proof motor | | |
| | a) Enclosure suitable (As per IS:2148) | : | As per requirement |
| | b) Classification of Hazardous area
(As per IS: 5572 part-I) | : | As per requirement |
| | c) Degree of protection | : | IP65 |
| 16.0 | Makes | : | AS PER ANNEXURE-I |
| 17.0 | Terminal box | : | Suitable to rotate at 90 degrees |
| 18.0 | Paint shade | : | Shade 631 of IS-5 |

All LT motors shall be controlled as follows:

- a) Up to 110kW: - Contactor operated.
- b) 110Kw to 175kW shall have ACB.

ANNEXURE III

[illegible]

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :							
				BIDDER/ VENDOR :		TITLE		NUMBER :							
								SPECIFICATION TITLE							
SHEET 1 OF 2		SYSTEM		QUALITY PLAN		NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE							
COMPONENT/OPERATION		CHARACTERISTICS CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		SECTION		VOLUME III	
SL. NO.		CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	7	8	9	10	11	AGENCY		REMARKS			
1	2	3	4	5	6	7	8	9	10	P	W	V			
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-				
			MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-				
			MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC./ RELEVANT IS	-DO-	2	-	-				
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUF'R'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-				
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1				NOTE -1 & NOTE-3	
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-			NOTE -1 & NOTE-3	
BHEL		PARTICULARS			BIDDER/VENDOR										
		NAME													
		SIGNATURE													

	QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION : TITLE :			
	SHEET 2 OF 2		SYSTEM CAT.		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION VOLUME III			
	SL. NO.	COMPONENT/OPERATION CHARACTERISTICS CHECK	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11
		3 NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2 1 -	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION. (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 2 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. 3 <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY										
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
BIDDER'S/VENDORS COMPANY SEAL										

		QUALITY PLAN SHEET 2 OF 9		CUSTOMER :		PROJECT		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SPECIFICATION :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS		
1	2	3	4	5	6	7	8	9	10	11		
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND. 2. CHEM. & PHYSICAL PROPERTIES 3. DIMENSIONS 4. INTERNAL FLAWS	MA MA MA CR	VISUAL CHEM. & PHYSICAL TESTS MEASUREMENT UT	100% 1/HEAT NO. OR HEAT TREATMENT BATCH NO 100% -DO-	- MFG. DRG. SPEC. -DO- ASTM-A388	FREE FROM VISUAL DEFECTS RELEVANT IS MANUF'R'S DRG. MANUF'R'S SPEC. BHEL SPEC.	-DO- SUPPLIER'S TC LOG BOOK -DO-	3 3 3 3	- - - 2	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, RTD'S	1. MAKE & RATING 2. PHYSICAL COND. 3. DIMENSIONS (WHEREVER APPLICABLE) 4. PERFORMANCE/ CALIBRATION	MA MA MA	-DO- MEASUREMENT TEST	-DO- SAMPLE 100%	- MANUF'R'S DRG. / SPEC. -DO-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY MANUF'R'S DRG. / SPEC. -DO-	-DO- -DO- INSP. REPORT	3 3 3	- - 2	FOR DIA OF 55 MM & ABOVE	
BHEL												
PARTICULARS				BIDDER/VENDOR								
NAME												
SIGNATURE												
DATE												
BIDDER'S/VENDORS COMPANY SEAL												

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :	
SHEET 3 OF 9		BIDDER/ VENDOR		BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-Q-007, REV-03		SPECIFICATION :	
SL. NO.	COMPONENT/OPERATION	SYSTEM		EXTENT OF CHECK		REFERENCE DOCUMENT		SECTION	
		CAT.	TYPE/ METHOD OF CHECK	CHECK	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	VOLUME III	
								P	W V
1	2	3	4	5	6	7	8	9	10 11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3 - 2
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2. DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA	TEST VISUAL	SAMPLE 100%	MANUF'S SPEC. -	MANUF'S SPEC. NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK AND OR SUPPLIER'S TC LOG BOOK	3 - 2 3 - -
1.9	CONDUCTORS	1. SURFACE FINISH 2. ELECT. PROP. & MECH. PROP	MA	MEASUREMENT ELECT. & MECH. TESTS VISUAL	SAMPLE -DO- 100%	MANUF'S DRG. . MANUF'S SPEC./ RELEVANT IS -	MANUF'S DRG. RELEVANT IS FREE FROM VISUAL DEFECTS	-DO- SUPPLIER'S TC LOG BOOK	3 - 2 3 - 2 3* - 2*
BHEL		PARTICULARS		BIDDER/VENDOR		SUPPLIERS TC & VENDOR'S INSPN. REPORTS		* 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.	
		NAME							
		SIGNATURE							
		DATE							
								BIDDER/SVENDORS COMPANY SEAL	

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :				
				TITLE		NUMBER :						
				BIDDER/ : VENDOR		TITLE						
		SHEET 4 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	SECTION	VOLUME III REMARKS	
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	MANFR'S DRG./ APPROVED DATASHEET	-DO-	Log Book	3	-	2
		1.MAKE & TYPE	MA	VISUAL	100%	100%	MANFR'S DRG./ APPROVED DATASHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2
		3.SURFACE FINISH	MA	VISUAL	100%	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	100%	-	-DO-	-DO-	3	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-
		3.TEMP.WITH- STAND CAPACITY	MA	ELECT.TEST	-DO-	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2
		4.HV/IR	MA	-DO-	100%	100%	-DO-	-DO-	-DO-	3	-	2
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-
		2.SURFACE COND.	MA	VISUAL	100%	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-
		BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME										
		SIGNATURE										
		DATE										
				BIDDER'S/VENDORS COMPANY SEAL								

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :					
				BIDDER/ : VENDOR		TITLE		NUMBER :		TITLE			
SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10	11			
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-		
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		
		2.TEMP. PRESSURE VACCUUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		THREE DIPS TO BE GIVEN
BHEL		PARTICULARS		BIDDER/VENDOR									
		NAME											
		SIGNATURE											
		DATE											
BIDDER'S/VENDORS COMPANY SEAL													

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :					
				BIDDER/ VENDOR		TITLE		NUMBER :		SPECIFICATION :			
SHEET 7 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE		VOLUME III		REMARKS			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	
1	2	3	4	5	6	7	8	9	10		11		
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY	
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
		1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.8	BRAZING/COMPRESSION JOINT	3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY	
		1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2	-	1		
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2	-	1		
		1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-		
2.10	ASSEMBLY	2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	VERIFICATION FOR MV MOTOR ONLY	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-		
		5.CORRECTNESS, COMPLETENESS/ TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-		
BHEL		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY	
		PARTICULARS					BIDDER/VENDOR						
		NAME											
		SIGNATURE											
				DATE								BIDDER'S/VENDORS COMPANY SEAL	

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :						
								TITLE		NUMBER :				
										SPECIFICATION :				
SHEET 8 OF 9		BIDDER/ VENDOR		QUALITY PLAN		TITLE								
COMPONENT/OPERATION		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		VOLUME III								
SL. NO.	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	REMARKS		
1	2	3	4	5	6	7	8	9	10				11	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3.VIBRATION & NOISE LEVEL 4.OVERALL DIMENSIONS AND ORIENTATION 5.DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1		
			MA	-DO-	100%	-DO-	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-			
			MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
			MA	-DO-	100%	-DO-	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	-DO-	100%	-DO-	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2		
			MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2		
BHEL		PARTICULARS		BIDDER/VENDOR										
		NAME												
		SIGNATURE												
		DATE												
				BIDDER'S/VENDORS COMPANY SEAL										

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
SHEET 9 OF 9		SYSTEM CAT.		TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK							P	W	V
1	2	3	4	5	6	7	8	9	10	11	
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 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 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY											
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
						BIDDER'S/VENDORS COMPANY SEAL					

VOLUME: V-A

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	CODES & STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA
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VOLUME: V-A

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

1.00.00 SCOPE

- 1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES & STANDARDS

- 2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:
- i) IS-325
 - ii) IS-12615
 - iii) IEC-60034

3.00.00 SERVICE CONDITIONS

- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.
- 4.02.00 **D.C. Motors**
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.
- 4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- Starter panel complete with all accessories shall be included in the scope of supply.
- 5.00.00 **PERFORMANCE**
- 5.01.00 **Running Requirements**
- 5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 **Starting Requirements**
- Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-
- | | | |
|---------------------|---|---|
| Motors up to 1500kW | - | 600% subject to IS tolerance of plus 20%. |
| Motors above 1500kW | - | 450% not subject to any positive tolerance. |
- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.
- 5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.
- b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

- 6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**

- 6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.
- 6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.
- 6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor		Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	:	25 mm
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 Grounding

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating		Conductor Size	
Above	Up to		
-----	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 Minimum Cable Size for LT & HT Motors shall as be as follows-

a) For 415V, 3-Ph, LT Motors-

Rating		:	Cable Size
Above	Up to		
-----	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating		:	Cable Size
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 Rating Plate

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

- i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).
- ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 Temperature Detectors

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V and 3300V motor bearing temperature.
 - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.
- 7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition, any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS: 7816 as routine test
- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.
- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.

- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.
- k. Over speed test as routine test.
- l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 To be Submitted with the bid

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write-up on forced lubrication system, if any
- d) Type test report

9.03.00 To be submitted for Owner / Purchaser's Approval and Distribution

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.V. Supply	11000 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 44 kA symm. for 1 sec.	Motors 1500 kW & above
M.V. Supply	3300 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 40 kA symm. for 1 sec.	Motors 175 kW and Up to less than 1500 kW.
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW and below 175kW.
	(ii) 240V AC/415V AC 240V, 1Ø, 2W, 50 Hz effectively earthed	Motors upto 0.2kW. Lighting, Space heat- ing , A.C supply for Contr- ol & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	$\pm 10\%$
Frequency	:	+3% to -5%
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242 Volt
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SECTION-IV

TECHNICAL SPECIFICATION FOR CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard.

Other cables including special cables, if any, which may be necessary as per proven engineering practice for satisfactory and trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

- | | | | |
|----|----------------------------|---|--------------|
| a) | 11kV & 3.3 kV Power cables | : | Annexure - A |
| b) | 1100V Power Cables | : | Annexure – B |
| c) | Control Cables | : | Annexure – C |
| d) | Fire Survival Cables | : | Annexure – D |
| e) | Flexible Trailing cable | : | Annexure – E |

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 Cables will be generally laid on ladder type trays or drawn through rigid PVC/GI /HDPE pipe/conduits. Cable tunnels shall be avoided as far as possible, except at locations where overhead trays are not possible, with prior approval of the Owner.

- 3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.
- 3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.
- 3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLSH) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.
- 3.06.00 Core identification for multicore cable shall be provided by colour coding.
- 3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **General Description**

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 **Drum Length and Tolerance**

The cables shall be supplied in non-returnable packing steel drum for 11 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.

4.03.00 **Non-Standard Length**

Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 **Cable identification**

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

- a) TSGENCO
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.
- f) No. of core and size of cables.
- g) Type of improved fire performance, e.g. FR/FRLSH/FS
- h) IS number

4.05.00 Packing

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

- a) TSGENCO
- b) Manufacturer's name or trade make
- c) Type of cable & voltage grade
- d) Year of manufacture
- e) Type of insulation e.g. XLPE/HRPVC/IE2
- f) No. of core and size of cables
- g) Cable code e.g. FRLSH/FS
- h) Length of cable on drum
- i) No. of length on drum, if more than one
- j) Direction of rotation, by arrow
- k) Approx. gross mass.

- I) IS/IEC number and ISI mark

4.06.00 **Joints and Terminations**

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 **Selection Criteria**

- 4.07.01 a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.
- b) While sizing power cables, following aspects shall be reckoned:
- i) Ground/Ambient Air temperature
 - ii) Depth of Laying.
 - iii) Power Cables touching each other.
- c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time 0.16 Sec. for outgoing feeder, 0.5 Sec. for Tie feeder and 1.0 Sec. for Incomer.
- d) HT cables shall be sized based on the following considerations:
- Rated current of the equipment and ground/ambient temperature.
 - Touching/spacing of cable.
 - Laying on multi-tier racks, trench
 - Depth of laying.
 - The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. For BFP motor, the voltage drop during motor starting condition shall be limited to 20% and for Mill motor shall be limited to 10%. Other outgoing feeder / transformer feeder shall be limited to 3% rated voltage.
 - Short circuits withstand capability
- e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered for loads fed from 415V PMCC. Incase of other out going line feeder voltage drop shall be limited to 3%.

- f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.
- g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.
- h) For welding receptacle, 3% running drop shall only be considered.
- The minimum sizes of L.T cable to be chosen are as below:
- AL - 16 mm² (3 core) & 16mm² (2 core) Cu - 2.5 mm²
- 4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.
- 4.07.03 The standard cable sizes, amp capacities, derating factors. as given in IS/IEC will be generally followed.
- 4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:
- | | | |
|--------------------|---|-------------------|
| 1100V Power Cable | : | 240 Sq mm XLPE AL |
| 3300V Power Cable | : | 185 Sq mm XLPE AL |
| 11000V Power Cable | : | 240 Sq mm XLPE AL |
- b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.
- 4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :
- | | | |
|--------------|---|------------|
| a) Aluminium | : | 6 Sq mm. |
| b) Copper | : | 2.5 Sq mm. |
- 4.07.06 All control cables shall be 2.5 Sq mm copper cable.
- 4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-9/C

	9 or 10	1-12/C
	Above 10	Two or more of above cables
4.07.08	Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.	
	a) Power.	
	b) Control, interlock and indication.	
	c) Metering and measuring.	
	d) Alarm and annunciation.	
	e) C.T. Cables.	
	f) V.T. Cables.	
4.08.00	Cable Identification	
	Cable identification shall be provided by embossing on the outer sheath the following :	
	a) Manufacturer's name or trade mark	
	b) Manufacturer's name or trade mark	
	c) Voltage grade	
	d) Year of manufacture	
	e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.	
	f) No. of core & size of cables	
	g) Type of outer sheath e.g. FRLSH, FS etc.	
4.09.00	Selected sizes of power and control cables are given in Annexure-G.	
4.10.00	Fire Survival Cables shall be used for important auxiliaries / area as recommended in Standard Technical Specification by CEA for the following services. The fire survival time of these cables shall not be less than 3 hours at 750 deg. C.	
	i. DC emergency lube oil pump	
	ii. DC hydrogen seal pump	
	iii. Turbine lube oil pump/barring gear	
	iv. DC emergency lighting for main building and service building	
	v. DC cables for battery to charger & DC distribution boards	

- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler Turbine : Generator inter trip which include the interconnection between
 - Boiler master fuel trip and turbine trip relays
 - Generator trip relays & turbine trip relays
 - Generator trip relays & generator breaker
 - Generator trip relays & field breaker
 - Generator trip relays & unit auxiliary transformer breaker
 - Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

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

- 5.01.01 Routine tests on each drum of cables.
- 5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.
- 5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 **Additional Tests**

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (category C1, Type FR/ Category C2, Type FRLSH)

- 5.02.01 Oxygen index test (both C1 & C2)
The Oxygen index shall not be less than 29.
- 5.02.02 Temperature Index Test (both C1 & C2)
The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables
- 5.02.03 Flame Retardance test on single cable and on bunched cables (both C1 & C2)
After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC-331

5.02.04 Halogen acid gas evolution test (for Category C2)

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test (for Category C2)

The cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for FS cable.

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-

- a) Swedish Chimney test – SS: 424-14-75
- b) IEEE std.383 – 1974 latest
- c) IEC std. 332-1, 332-3 and IEC 331

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or

6.02.00 **To be submitted with the Bid**

- a) Manufacturer's catalogues giving cable construction details and characteristics.

- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test reports on 11 KV & 3.3 KV Power, LT FRLSH Power & control, FS power and control cables.
- e) Filled-up proposal particulars.

6.03.00 To be submitted for Owner/Purchaser's Approval and Distribution

All relevant drawings and data pertaining to the equipment like GTP, QAP, etc. shall be submitted by the Bidder for the approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

RATINGS AND REQUIREMENTS HV POWER CABLES (11 KV & 3.3 KV)

- | | | | |
|-----|--|---|--|
| 1.0 | 11000/11000V & 3300/3300V grade 90°C continuous rating under normal condition and 250°C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen. | | |
| 1.1 | Conductor | : | Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130. |
| 1.2 | Conductor Screen | : | Extruded semi-conducting compound. |
| 1.3 | Insulation | : | Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2) |
| 1.4 | Insulation Screen | : | Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable. |
| 1.5 | Core Identification | : | By coloured strips applied on (For three core cables) cores. |
| 1.6 | Inner Sheath | : | Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC. |
| 1.7 | Armour | : | Galvanised single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables |
| 1.8 | Overall Sheath | : | Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831. |
| 1.9 | Drum | : | Steel Drum |

ANNEXURE-B

**RATINGS AND REQUIREMENTS
LV POWER CABLES [1.1KV (XLPE TYPE)]**

- 1.0 1100 V grade, 90°C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
- 1.5 Armour : Galvanized single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.6 Overall Sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS-10418 (Wooden drum)

ANNEXURE-C

**RATINGS AND REQUIREMENTS
CONTROL CABLES**

- 1.0 1100 V grade 85°C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
- 1.2 Insulation : Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner sheath : Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
- 1.5 Armour : Galvanised single round steel wire for twin and multicore cables.
- 1.6 Overall sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS: 10418 (Wooden drum)

ANNEXURE-D

**RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)**

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 750 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

**RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)**

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 750 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

ANNEXURE-E

**RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES**

i) 3300 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.

ANNEXURE-F

CABLE SIZES

Following sizes are given as a general guideline. Standard sizes as per IEC/IS shall be adopted.

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES (11kV)		
1.1	1 core 1000 sq.mm	AL	XLPE (FRLS)
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	H. T. CABLES (3.3kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.3	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.4	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.6	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.7	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 70 Sq.mm	AL	XLPE (FRLS)

Sl. No.	Cable Size	Conductor	Insulation
2.9	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.11	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.18	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	CONTROL CABLE		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	FS POWER CABLES		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	FS CONTROL CABLE		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

VOLUME

SECTION

REVISION 00

DATE: 03/04/2015

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SECTION – C.4

SPECIFIC TECHNICAL REQUIREMENTS (C & I)

	Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) COMPRESSED AIR SYSTEM	
<u>SPECIFIC TECHNICAL REQUIREMENTS (C&I)</u> 1.0 Complete C&I system for Compressed Air System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder. 2.0 Control, Protection & interlocking system for individual compressors shall be achieved through skid mounted redundant microprocessor based controllers with Graphic User Interface (GUI) with LCD screen based display unit, control switches and other operational keys. Controllers shall be hooked-up to Plant DDCMIS RTU through dual two way redundant Ethernet soft link. 3.0 In addition to above Compressed Air System shall be controlled and monitored from plant DDCMIS. To achieve these operational & functional requirements, hardwired signals shall be provided/accepted for DCS use. Number of hardwired signal shall be decided during detailed engineering. 4.0 For realizing total loading/unloading cycles, standby start logic, remote start-up logic, Group control of air compressors, bidder shall furnish the required logic, control write-up and HMI graphics for overall operation of the compressor from DCS, during detailed engineering. 5.0 Integrated microprocessor based control system along with suitable operator interface shall be provided for each Instrument Air Compressor & Service Air Compressor. All PT, DPT, TE, and other instruments outside the compressor skid shall also be hooked-up to this system. Dual two way redundant Ethernet connectivity to DCS shall be provided through optical fiber link for information. In addition to the soft link, provision for hardwired START, STOP, LOAD & UNLOAD commands from DCS to all the compressors & their status feedbacks to DCS shall also be provided. Bidder to furnish the configuration diagram of control system of compressor showing communication with DCS along with the bid. 6.0 All H.T. motors shall have provision for VMS sensors on DE & NDE bearings of motors and fans/pumps/compressors. Each bearing shall have two vibration sensor, one in X direction and other in Y direction along with key phasor for online vibration monitoring and analysis. 7.0 Bidder to include all the instruments (PG, PS, LS, TS, Dew Point meter, etc.) required for the package along with fittings, accessories and valve manifold. 8.0 The solenoid operated valves shall have limit switches for open/ close feedback. 9.0 All motor operated valves/electric actuators shall be envisaged with integral starter. 10.0 In case of HT motors, winding temperature for each stator winding and bearing temperature of motors & driven equipment shall be monitored on LCP for abnormal rise.		

	Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) COMPRESSED AIR SYSTEM	
11.0 All pneumatic operated regulating control valves shall be envisaged with smart positioner. 12.0 The junction boxes for termination of instruments /actuator limit switches/ solenoid valve limit switches etc. are in bidder's scope. 13.0 415 V AC (3 Phase, 3 Wire) supply shall be provided by BHEL at a single point as per 'Electrical scope split sheet' in Electrical portion of the specification. Further distribution to various instruments/Equipment shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope. No other power supply shall be provided. 14.0 Bidder to delegate/depute their person/experts as per owner/consultant requirements. 15.0 Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, Cable Interconnections details for Complete System shall be in Bidders' scope. 16.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification. 17.0 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial 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. In case of any contradiction most stringent clause/condition shall prevail. 18.0 The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc. 19.0 Bidder shall provide the signal exchange, to Plant DCS in BHEL prescribed format to be furnished during detailed engineering. 20.0 Drawings/Documents and data to be furnished after award of the contract. • Control & operational write-up for the system • Recommended control scheme/ logic diagram • Configuration diagram of control system • Process manuscript for implementation in DCS • Drive List and I/O list		

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	Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) COMPRESSED AIR SYSTEM	
• Power requirement and grounding scheme. • Field instruments quality plan. • Instruments data sheet. • JB/LIE/LIR Grouping document • Cable schedule and cable interconnection drawing. • Instrument schedule • Any other document decided during detailed engineering.		

	Technical specification for CONTROL & INSTRUMENTATION 1X800 MW KOTHAGUDEM	SPEC NO.: PE-TS-410-145-I	
		VOLUME	
		SECTION 'D'	
		REV. NO. 00	DATE : 17.03.2015
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- 10.ERECTION HARDWARE
- 11.MANDATORY SPARES



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 17.03.2015

SHEET

OF

INSTRUMENTATION DATA SHEET

1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy : $\pm 0.075\%$ of Span or better

-
- ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
- a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts
 - c. Siphon for steam and hot water services
 - d. 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. 1/2" NPT cable gland
 - g. Handheld calibrator
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
- Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.
LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

- 1. Working Principle : Smart (HART Compatible)
- 2. Type : Microprocessor based, 2 – Wire
- 3. Output Signal : 4-20 mA DC along with superimposed digital signal
- 4. Measuring Element : Capsule / Diaphragm

-
- | | | | |
|-----|---------------------|---|---|
| 5. | Element material | : | SS-316 (Stainless Steel) or better |
| 6. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration |
| 7. | Turn-down ratio | : | 100: 1 |
| 8. | Span and Zero | : | Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span |
| 9. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 10. | Output Indicator | : | LCD (Integral indicator of 5 digit display) |
| 11. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 12. | Body | : | SS |
| 13. | Operating Voltage | : | 24V DC |
| 14. | Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 15. | Ambient Temperature | : | 0 - 50 °C |
| 16. | Performance: | | |
| | i. Accuracy | : | ± 0.075% of Span or better |
| | ii. Repeatability | : | ± 0.05% of Span or better |
| 17. | Sealing/Isolation | : | Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications |
| 18. | Accessories | : | a. Universal mounting bracket suitable for 2" pipe mounting

b. High tensile carbon steel U-bolts |

- c. Siphon for steam and hot water services
- d. ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½" NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

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.

3.00.00 **PROCESS ACTUATED SWITCHES**

3.01.00 **PRESSURE SWITCH**

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale.
Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy $\pm 1.0\%$
 - b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature : 0 – 50 Deg.C

-
14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 2 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

-
- | | | |
|-------------------------|---|--|
| 6. Adjustments | : | a) Internal Set Point |
| | : | b) Differential adjustment |
| 7. End Connection | : | 1/2" NPT bottom/ back connected |
| 8. Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 9. Switch Type | : | Snap acting, shock & vibration proof |
| 10. Terminal Block | : | Suitable for full ring lugs |
| 11. Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 12. Performance | : | a) Repeat accuracy $\pm 1.0\%$ |
| | | b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 13. Ambient temperature | : | 0 – 50 Deg.C |
| 14. Nameplate | : | Tag number, service engraved in SS tag plate |
| 15. Accessories | : | a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications |
| | | b) Snubbers for pulsating fluid applications |
| | | c) Siphons for steam and hot water services |
| | | d) Retention ring and screws for surface mounting |
| | | e) 1/2" NPT 5 Valve SS-316 barstock manifold |
| | | f) 1/2" NPT cable gland |
| 16. Applications | : | During Detail Engineering on Owner's |

d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

6. Input Supply Voltage : 240V AC $\pm$ 10%, 50 Hz.
Four independent channel with
7. Input : selectable switching threshold for water conductivity
8. Relay Output : 2 SPDT (240V AC, 5A)
9. Ambient Temperature : 50 °C
10. Enclosure Protection : IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11. Enclosure Housing : SS
HI,LO, HIGH-HIGH, LOW-LOW
12. Local LED Indication : Power
Fault
13. Accessories :
 - a) Interconnecting cable from probe to electronics
 - b) Mounting accessories
 - c) External cage
 - d) Washer & Gasket
 - e) ½" NPT Cable Glands
 - f) SS Tag Plate
14. Application : During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

1. Type : Bimetallic or gas filled
2. Sensing Element : SS-316
Material
3. Bulb Material : SS-316
4. Capillary : Stainless Steel armored

-
- | | | | |
|-----|-----------------------|---|--|
| 5. | Movement Material | : | Stainless Steel |
| 6. | Case material | : | Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 7.. | Scale | : | Black graduation on white linear scale. Graduation 0-100% with red pointer for set points |
| 8. | Over range Protection | : | 120 % |
| 9. | Instrument connection | : | Bottom |
| 10. | Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 11. | Switch type | : | Snap acting, shock and vibration-proof |
| 12. | Adjustability | : | Internal Set point adjustable over span range |
| 13. | Compensation | : | a) Capillary compensation with invar wire throughout the capillary length
b) Case compensation |
| 14. | Performance | : | |
| | a) Scale Accuracy | : | ±1.0 % of full scale |
| | b) Repeatability | : | < 0.5 % of full range |
| | c) Response time | : | Less than 40 seconds with thermowell |
| 15. | Capillary length | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting |
| 16. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 17. | Accessories | : | Mounting accessories, ½" NPT cable gland |
| 18. | Applications | : | During Detail Engineering on Owner's |

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

- | | | |
|--------------------------|---|--|
| 1. Type | : | Bourdon/Bellows/Diaphragm |
| 2. Sensing & Socket | : | SS-316 |
| 3. Movement Material | : | SS-316 |
| 4. Case Material | : | Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 5. Dial Size | : | Generally 150 mm |
| 6. Scale | : | Black lettering on white in 270 O arc. |
| 7. Window | : | Shatterproof glass |
| 8. Range Selection | : | Normal process pressure: 50~70 % of range |
| 9. Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero |
| 10. Adjustment | : | For Zero adjustment (Micrometer screw external)
For Range adjustment (Micrometer screw internal). |
| 11. Element Connection | : | Argon welding |
| 12. Process Connection | : | 1/2" NPT (M) Bottom for local, back for panel mounting |
| 13. Performance | : | Accuracy of ± 1.0 % of span or better |
| 14. Operating ambient | : | 0 - 50 °C |
| 15. Safety Feature | : | Blow out disc /diaphragm at the back |
| 16. Accessories | : | a) Snubbers for pulsating fluid application.discharge
b) Stainless steel Diaphragm seals |

- for corrosive/ viscous/ solid bearing or slurry type fluid applications
- c) 3-Way SS316 Gauge cock for pressure gauges
- 5-valve SS316 manifold from
- d) barstock for differential pressure gauge
- e) Siphons for steam and hot water services
17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board
2. Float Material : SS-316
3. Float Cable : SS-316
4. Indicator Assembly : Epoxy painted Aluminium
5. Guide wire spring assembly : SS-316 (2 Nos.)
6. Guide Wire Anchor : SS-316
Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board :
mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly : Anodized Aluminium
9. Flanges : RF , ANSI 150 , SS (3 Nos.)
10. Accuracy : ± 10 mm or better
11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material :
Glass : Toughened borosilicate resistant to thermal shock
Body Material : ~~Carbon Steel~~ Stainless Steel
Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings :
i. SS 316
Rubber lined corrosion resistant
4. :
ii. stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories :
i. Integral cocks
ii. Drain Valves
iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
iv. Illuminating lamps, Mica shield as required
v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 °C
For larger lengths (greater than 1200mm), additional gauge glasses
9. Other details : shall be provided with minimum of 50 mm overlap.

- | | | |
|------------------------|---|--|
| 10. Test Pressure | : | 200% of maximum operating pressure |
| 11. Scale | : | 250 mm nominal length |
| 12. Graduation | : | Direct reading |
| 13. Process Connection | : | Flanged (RF) to line size as per ANSI standards (150#) |
| 14. Tapping | : | D & D/2 |
| 15. Accuracy | : | +/- 2% of full scale reading |
| 16. Reproducibility | : | Within 0.5% of instantaneous reading |
| 17. Accessories | : | SS Tag Plate, orifice plate |

5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES

5.01.00 RESISTANCE TEMPERATURE DETECTOR

- | | | |
|----------------------------------|---|--|
| 1. Type | : | Platinum (Duplex), Ungrounded |
| 2. Platinum (Duplex), Ungrounded | : | 100 ohm at 0 °C |
| 3. Base | : | Wound on ceramic (anti-inductive) |
| 4. Wiring | : | 3 Wire |
| 5. Protecting Tube | | |
| a) O.D. | : | 6 mm |
| b) Material | : | SS-316, Seamless |
| c) Filling | : | Magnesium oxide (Purity above 99.4%). |
| 6. Response time | : | a) 15 sec. (bare).
b) 30 sec. (with thermowell) |
| 7. Calibration | : | DIN 43760 |
| 8. Accuracy | : | ± 0.5% |
| 9. Head | | |
| a) Type | : | IP-65 universal screwed type |

-
- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.
- Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
- Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
10. Accessories : a)
- b) Compression fittings/unions
- Flanges etc. (for flanged connections only)
- c)
- Thermowell (As specified below)
- d)
11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- Tag number, service engraved in
12. Nameplate : stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing 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 Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
 - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
 - a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element : Bourdon – SS-316
3. Bulb and Capillary : SS-316
4. Capillary Tubing : Inner sheath - solid drawn Material
copper tube
Outer sheath - PVC tube
5. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
6. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

- cover conforming to IP 65.
7. Dial size : 150 mm
 8. Scale : Black lettering on white background in 270 Deg.C arc
 9. Over range protection : 125 percent of FSD
 10. Capillary Glanding : 1/2" NPT(M) x compression fitting (SS) to suit capillary
 11. Instrument Connection : Bottom connection for local mounting, back connection for panel mounting
 12. Process Connection : 1/2" NPT (M) or 150 RF Flanged
 13. Extension Neck Length : 50 mm
 14. Compensation : a) Capillary compensation
 15. : b) Case compensation
 16. Performance : a) Accuracy : + /- 1.0 percent of full scale Deflection
 - : b) Repeatability : Less than 0.5 percent of full range
 - : c) Response time: 15 seconds (max.).
 17. Capillary length : 3.0 meters (local) / 15.0 metres (local panel)
 18. Other features : Shatter proof glass
 19. Nameplate : Tag number, service engraved in stainless steel tag plate
 20. Accessories : SS316 Thermowell

5.04.00 THERMOWELL

1. Material : SS-316
2. Manufacture : Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

3. Process connection : M33x2
4. Certification : Not applicable
5. Bore concentricity : +5% of wall thickness
6. Identification mark : Tag number punched on head
7. Surface treatment : Polish after machining
8. Element connection : ½" NPT (M) or 150 RF Flanged
9. Head : Hex
10. Length of the hex head : 31.75 mm (min.)
11. Accessories : SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections.

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1. Measuring medium : Metal temperature
2. Type : Chromel Alumel (Type-K)
Duplex, Ungrounded
3. Insulation : Mineral Insulation Magnesium Oxide
4. Wire gauge : 16 AWG
5. Protective sheath : SS
6. Protective sheath :
diameter 8 mm O.D.
7. Characteristics : Special limits of error as in ANSI
thermocouple MC 96.01
8. Accessories : ½" BSP SS sliding end connector, weld
pad, clamps of heat resistant steel

1. Type : Hydrometer Type
2. Mounting : On line
3. Accuracy : +/- 2% of range
4. Scale : Black letter on white scale
5. End connection : PVC flange

9.06.00 DENSITY/ CONCENTRATION METER

1. Wetted Part : Stainless Steel
2. Enclosure : Stainless Steel (IP-65)
3. Power Supply : 24 V DC
4. Output signal : 4-20 mA DC (isolated) into 600 ohms
5. Accuracy : ± 0.001 g/cc
6. Indication : LCD display
7. Temp. Compensation : Integral
8. Accessories : Mounting hardware, integral amplifier
(if required), cable glands, tag plate
etc.

10.00.00 SOLENOID VALVES

1. Operating Principle : Electromagnetic (noiseless)
2. Coil voltage rating : 240 V AC /24 V DC (as required)
3. Ways : 2/3/4 way
4. Port size : 1/4" NPT all ports
5. Body : SS bar stock
- Trim : SS-316
6. Duty : Suitable for continuous energization
7. Sealing : Airtight and leak proof
8. Ambient Temperature : 0 - 50 ° C

-
- | | | | |
|-----|-------------------|---|--|
| 9. | Fluid Temperature | : | 0-150 ° C (approx.) |
| 10. | Coil Enclosure | : | Stainless Steel |
| 11. | Insulation | : | Class-H |
| 12. | Coil Casing | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 13. | Mounting | : | On pipe or on panel |
| 14. | Cable Connection | : | ½" NPT |
| 15. | Accessories | : | Cable glands, SS Tag plate |

individual weighbridge terminals located at Track Hopper complex. The quantity & location however shall be decided during detail engineering stage. The accuracy of weighing shall fall within $\pm 0.25\%$.

7.07.00 **ANEMOMETER** shall be provided on the stacker & re-claimer to measure the wind velocity and direction of wind. Instrument shall comprise of sensors, control unit and display unit. Interface with PLC shall be furnished for alarm.

8.00.00 DEW POINT METER

1. Type : Direct Mounting Capacitance type with change in output proportional to moisture present.
2. Sensing Element : Ceramic / Aluminum Oxide sensor
3. Service : Dry Air
4. Range : -90 Deg.C to 10 Deg.C Dew Point Temperature
5. Sensor Accuracy : ± 2 Deg. C Dew Point
6. Repeatability : 0.5 Deg. C Dew Point
7. Operating Ambient Temperature : -40 Deg C to 50 Deg C
8. Operating Pressure : 0- 10 kg/ Sq. cm
9. Display : Combined enclosure with 5 Digit seven segments LED display.
10. Element Filter : 80 micron sintered stainless steel
11. Output : 4- 20 mA DC Loop powered
12. Power Supply : 24 VDC nominal
13. Enclosure class : IP 65
14. Interchangeability : Fully Interchangeable transmitters
15. Accessories : Sampling system, cables, sensor holder, desiccant chambers, double compression fittings, $\frac{3}{4}$ " Cable gland, mounting fixture etc.



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 17.03.2015

SHEET

OF

ACTUATOR SPECIFICATION

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

2.00.00 STANDARDS

- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS-9334
 - ii) IS-325

3.00.00 SERVICE CONDITIONS

- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 RATING

- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 SPECIFIC REQUIREMENT

6.01.00 Construction

- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 Motor

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 TEST

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

9.00.00 DRAWINGS, DATA & MANUALS

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 To be submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 To be submitted for Owner / Purchaser's Approval and Distribution

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW upto less than 175kW.
	(ii) 240V AC/415V AC 240V, 1Ø, 2W, 50 Hz effectively earthed	Motors upto 0.2kW. Lighting, Space heating , A.C supply for Control & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%.
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242
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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 17.03.2015

SHEET

OF

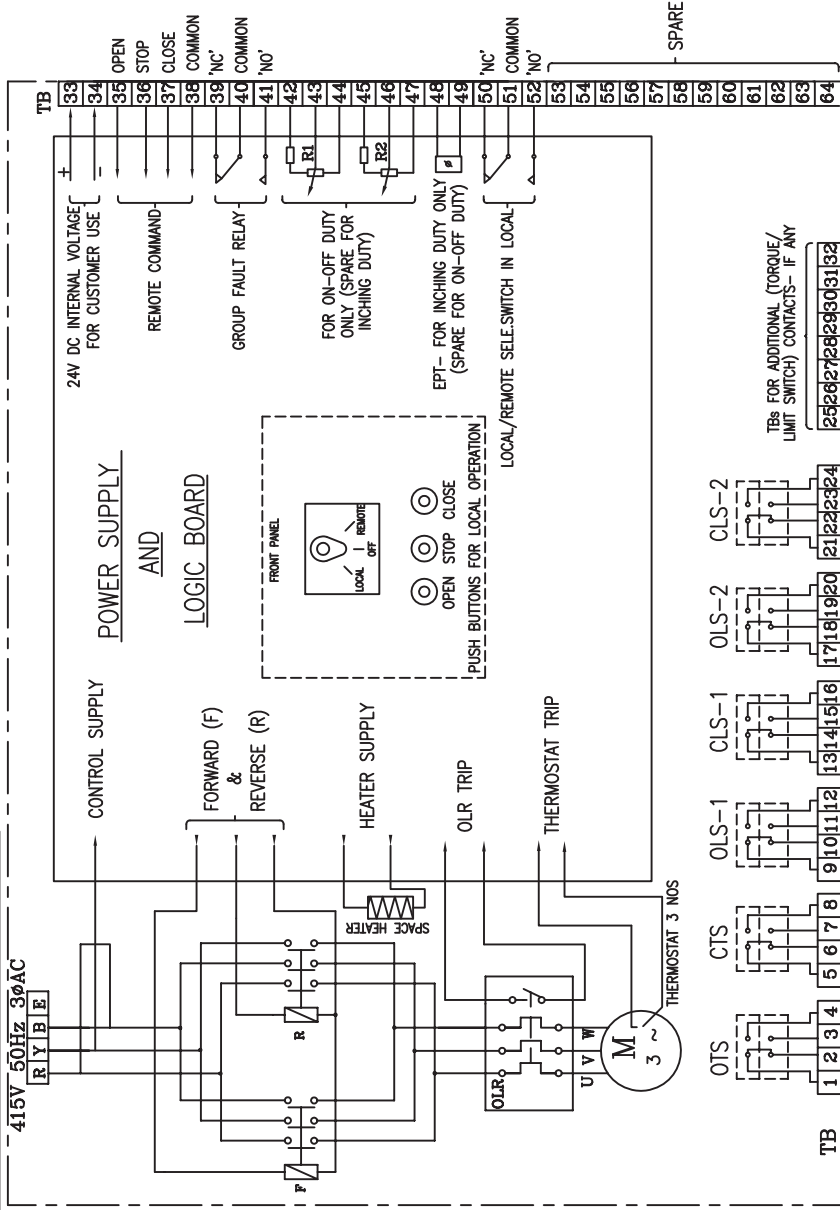
Actuator Data Sheet

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	1	OF
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL *	* PROJECT	1 X 800 MW KOTHAGUDAM TPS			
	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, DUST TIGHT, WEATHER PROOF, SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, IP:65		
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 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 ☒ DRG. NO. 3-V-MISC-24227 R00 (INDICATIVE)			
	COLOUR SHADE	☒ BLUE (RAL 5012), To be decided during detail engg.			
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐			
	SHAFT RPM	BIDDER TO SPECIFY			
	OLR SET VALUE	BIDDER TO SPECIFY			
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY			
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY			
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC, 3 WIRE			
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V			
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 65 ☐ FLAME PROOF			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	2	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
INTEGRAL STARTER	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ _____			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
	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 ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ 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 ☐ 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 ☐ > _____ 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) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No. ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			

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			VOLUME		
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			REV. NO.	00	DATE: 06.01.2015
			SHEET	3	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
POSITION TRANSMITTER	POSITION TRANSMITTER	☒ REQUIRED ☐ NOT REQUIRED			
	MFR & MODEL NO.	BIDDER TO SPECIFY			
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS			
	SUPPLY	☒ 24V DC ☐			
	OUTPUT	☒ 4-20mA			
	ACCURACY	± 1% FS			
SPACE HEATER	@SPACE HEATER	REQUIRED			
	@ POWER SUPPLY (NON INTEGRAL)	240V AC, 1 PH., 50 Hz			
	@ POWER SUPPLY (INTEGRAL)	240V AC, 1 PH/415/240 V CTRL TRANSFORMER WITH PRIMARY AND SECONDARY FUSES			
	@ RATING				
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED			
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐			
	@ EARTHING TERMINAL	REQUIRED			
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐			
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----			
	@ SPACE HEATER CABLE GLAND	SIZE:-----			
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)			
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE: 1no., 2.5 sq. mm			
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.	
NOTES: SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL, WITH NICKEL COATING SHALL BE PROVIDED. - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.					
			VENDOR COMPANY SEAL NAME SIGNATURE DATE		
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES					

DRAWING NO. 7227-CSIW-A-E



SWITCH TERMINALS FOR CUSTOMER USE

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRANSMITTER
(Contactless , FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3Ø 415V 50 Hz AC SUPPLY

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL											
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL											
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL											
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL											
OLS-1	9-10												
	11-12												
CLS-1	13-14												
	15-16												
OLS-2	17-18												
	19-20												
CLS-2	21-22												
	23-24												
SWITCH	TERMINAL NO.	FULL OPEN		INTERMEDIATE		FULL CLOSE							
		VALVE POSITION											
————— INDICATES CONTACT CLOSED													
----- INDICATES CONTACT OPEN													
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC													

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH					
VALVES			OPEN		CLOSE
			MAIN	BACK UP	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS			OLS	OTS *	CLS CTS
ALL OTHER GATE & GLOBE VALVES			OLS	OTS *	CTS #
# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT					
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)					

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
OR NAME OF CUSTOMER/PROJECT (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

		BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPPALLI-620014.				DRN		NAME N.P.ESWAR		SIGN N.P		DATE 07.10.04		NO. OF VAR.	
365-121		SCALE				WEIGHT (KG).		APPD		K.ARUNACHALAM		D.D		07.10.04	
DEPT		VL													
CODE															
TITLE		WIRING DIAGRAM (TERMINAL PLAN)				CARD CODE		DRAWING NO.				REV			
		FOR ACTUATOR WITH INTEGRAL STARTER				U 01		3-V-MISC-24227				0			

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	Technical specification for CONTROL & INSTRUMENTATION 1X800 MW KOTHAGUDEM	SPEC NO.: PE-TS-410-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 17.03.2015
		SHEET	OF

LCP and JUNCTION BOXES SPECIFICATION

- 1.00.00 **GENERAL REQUIREMENT**
- 1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
- 1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00 SURFACE PREPARATION & PAINTING
- 1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
 - Interior - Brilliant White.
- 1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00 WIRING
- 1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, 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, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room 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 Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

- 2.02.05 Design shall include Earthing bolts.
- 2.02.06 Back installed items shall be suitably concealed from front view.
- 2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.
- 2.02.08 **HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)**
- Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.
- 2.03.00 **BACK UP PANEL**
- 2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.
- 2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.
- 2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.
- 2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

- | | | | |
|----|--------------------------|---|---|
| 1. | Material of Construction | : | Cold Rolled Coal Annealed (CRCA) steel sheet |
| 2. | Thickness of Sheet | : | a) 2.0 mm for faces supporting instruments / terminals
b) 1.6 mm for other sides and top |
| 3. | Construction | : | Welded throughout as per approved National Standards |
| 4. | Post welding operation | : | a) Grounding of all welds to smoothness
b) Rounding of corners |

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures

- | | | |
|---------------------------------|---|--|
| 12. Name Plate | : | Both at front and back surface of the panel |
| 13. Fixing of name plate | : | Stainless steel pan head screws |
| 14. Name plate material | : | Laminated phenolic (3 layers) |
| 15. Lettering | : | Black with white engraved |
| 16. Mounting of terminal blocks | : | Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure |

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

- 4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.
- 4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- 4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- 4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

- 4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

- | | | |
|----------------------|---|--|
| 1. Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65 |
| 2. Material | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized) |
| 3. Type of Cover | : | Solid unhinged with retention chain / Screwed at all four corners |
| 4. Paint | : | i) Exterior : Opaline green shade 275 of IS: 5
ii) Interior - Brilliant Glossy White. |

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
 6. Cable Entry : 3 mm (min) Bottom / side Gland plate
 7. Gasket : Neoprene
 8. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no. (M6)
 9. Number of Drain Holes : Two at bottom capped
 10. Identification : Label for JB and Tags for cable
 11. Accessories :
 - Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
 - a) conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
 - b) Cable gland (Brass) & raceways
 - c) Ferrules & lugs (Brass)
 - d) Aluminum back panel
 - e) Canopy at top
 - f) Mounting brackets
 - g) bolts and nuts made of brass etc.



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 17.03.2015

SHEET

OF

Instrumentation Quality Plan



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

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	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST				P	V	V
4	ELECT. INSULATION/HV TEST	ONE	P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT	V	V	V		
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT	V	V	V		

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material correlation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

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	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION	ONE		P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	FOR LOT		P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE			P	W	V	
5	REVIEW OF TC FOR			V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

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 / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

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/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



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	FUNCTIONAL TEST			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 17.03.2015

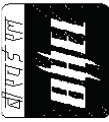
SHEET

OF

LCP Quality Plan

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL												STD QUALITY PLAN NO.: PE-QP-999-1 -IO 6			
भारतीय वैद्युत बोर्ड BHEL PEM :: C&I												VOLUME IIB			
												SECTION D			
												REV. NO. 01 DATE: 22-02-2008			
												SHEET 1 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency			Remarks			
									P	W	V				
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2				
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---				
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---				
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---				
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---				
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1				
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---				
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---				
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---				
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1				
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics												P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.			
												1 - BHEL 2 - Vendor 3 - Sub-vendor			

भारतीय विद्युत निगम BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-1 -IO 6									
												VOLUME IIB									
												SECTION D									
												REV. NO. 01					DATE: 22-02-2008				
												SHEET 2 OF 7									
												Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency
									P	W	V										
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---										
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2										
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	for relay & contactors only for all components except relays & contactors.									
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---										
		3. Operation / Functional check	CR	Electrical	Sample 100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---										
		4. I.R.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---										
		5. H.V.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---										
		6. Calibration	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	1										
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---										
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor																					

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-1 -10 6									
 PEM :: C&I										VOLUME IIB									
										SECTION D									
										REV. NO. 01					DATE: 22-02-2008				
										SHEET 3					OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency			Remarks							
									P	W	V								
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---								
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---								
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---								
8.0	ASSEMBLY Frame Assembly & Sheet fitting	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2								
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics										P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.		1 - BHEL 2 - Vendor 3 - Sub-vendor							

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL		STD QUALITY PLAN NO.: PE-QP-999-1 -10 6										
PEM :: C&I		VOLUME IIB										
		SECTION D										
		REV. NO. 01 DATE: 22-02-2008										
		SHEET 4 OF 7										
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-1 -10 6			
										VOLUME IIB			
										SECTION D			
										REV. NO. 01			
										DATE: 22-02-2008			
SHEET 5 OF 7													
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency			Remarks	
									P	W	V		
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	---	
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	---	
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	---	
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	1	
			MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	1	
11.	Component Mounting	1. Correct components 2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	---	
			MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	---	
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fitting of all components 3. Components identification Marking / Name plates	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
			MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
			MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor													

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

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL												STD QUALITY PLAN NO.: PE-QP-999-1 -10 6			
PEM :: C&I												VOLUME IIB			
												SECTION D			
												REV. NO. 01 DATE: 22-02-2008			
												SHEET 6 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency			Remarks			
									P	W	V				
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.			
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1				
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1				
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1				
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1				
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1				
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1				
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1				

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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 STD QUALITY PLAN NO.: PE-QP-999-1 -10 6		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 7 OF 7			
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency			Remarks	
											P	W	V		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1				
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1				
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1				
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1				
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1				

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 15.03.2015

SHEET OF

CABLE TYPE

CABLE SIZES FOR 1X800 MW KOTHAGUDEM TPS	
Sl no.	Cable Type
	G-TYPE (Binary Signals)
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
5	2P X 1.5 sqmm
	F-TYPE (Analog Signals)
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
	CONTROL CABLE
1	3C X 2.5 sqmm
2	5C x 2.5 sq mm
3	12C x 2.5 sqmm



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

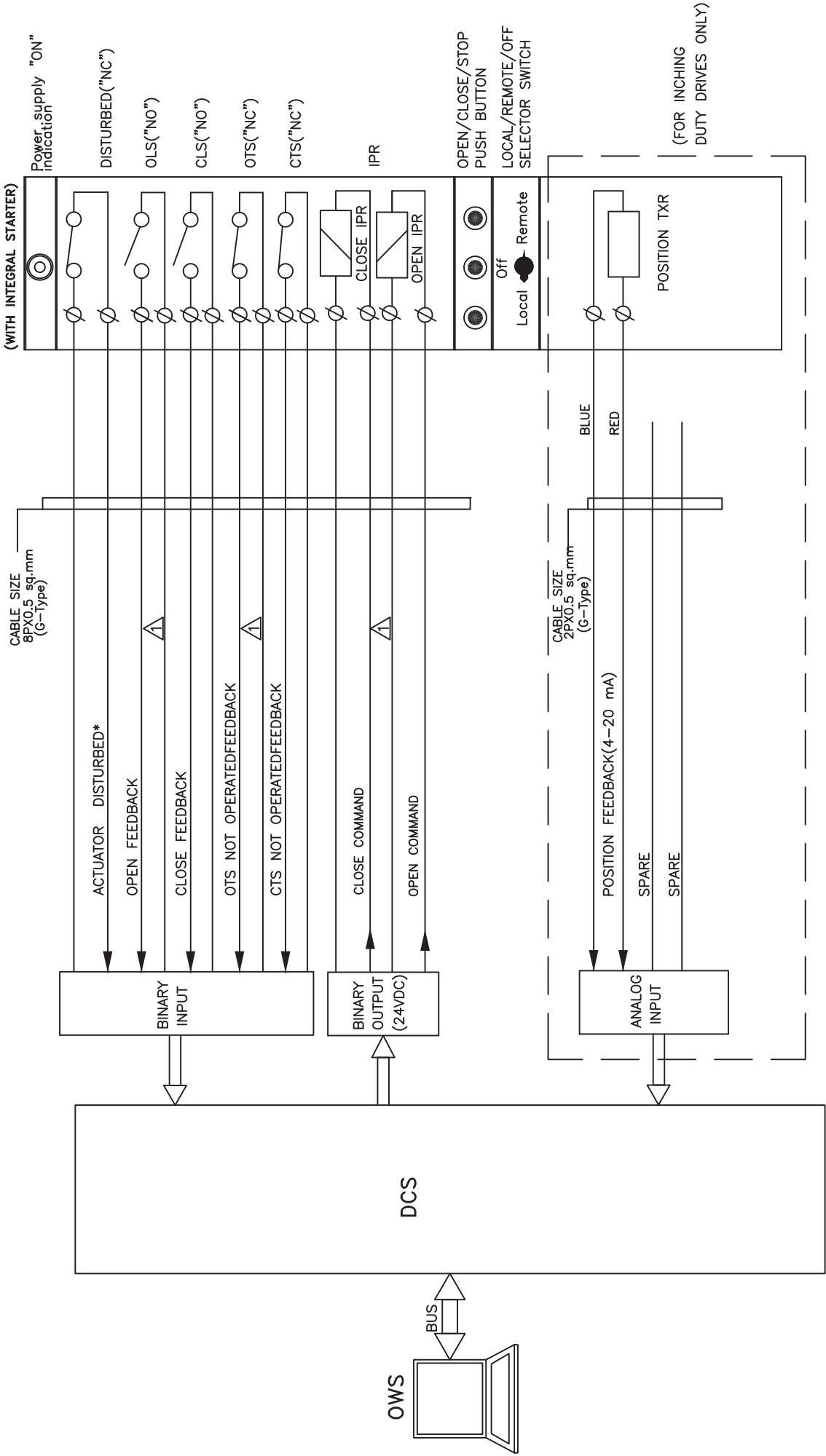
DATE : 17.03.2015

SHEET

OF

Drive Control Philosophy

DCS INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)

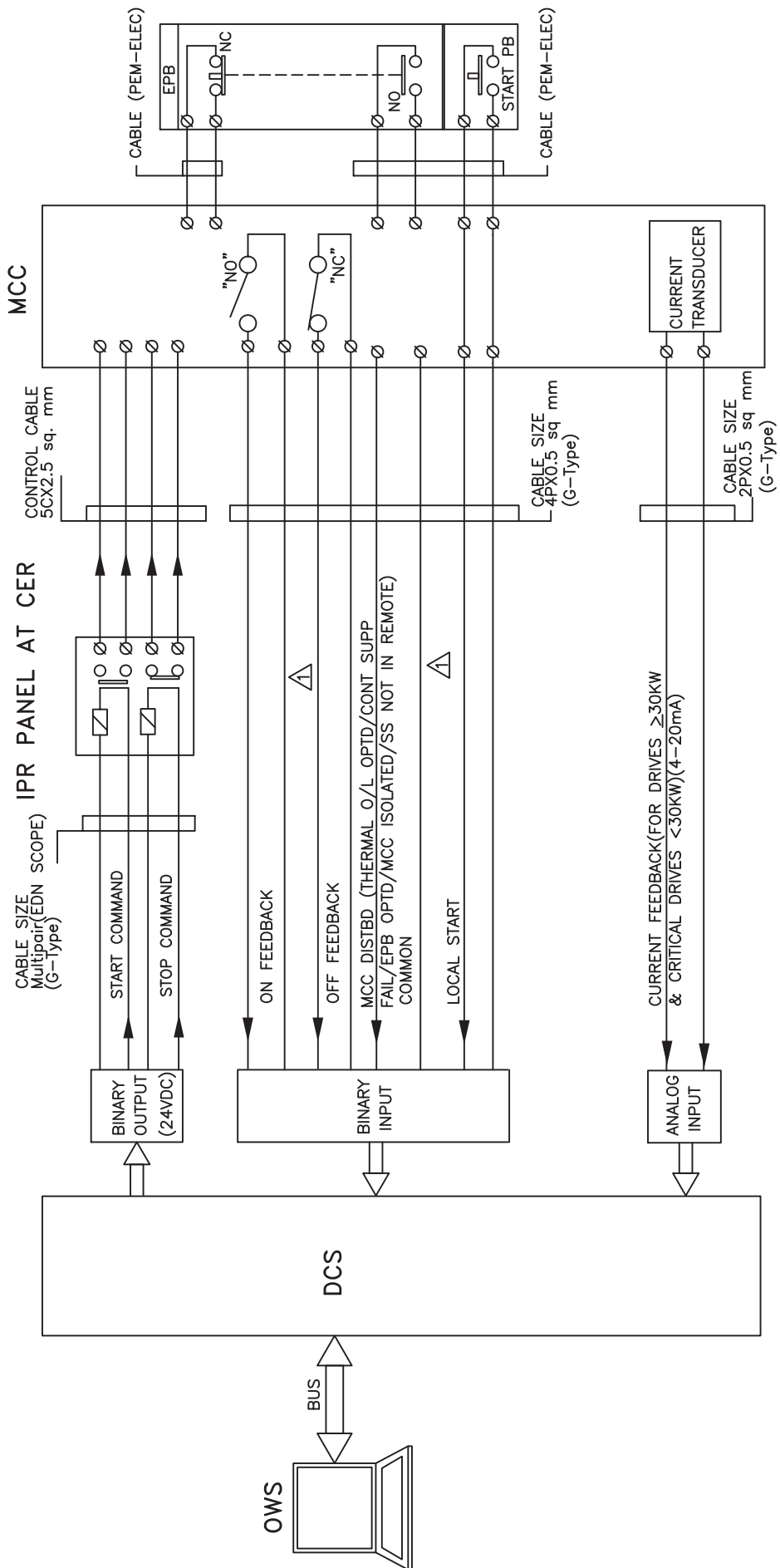


NOTE:

- * DISTURBED= Loss of Power supply (1 Phase/3 Phase)/ Loss of control supply/ Motor thermostat trip/ Thermal over load/Torque open/close out off mode/ Local/Off/Remote Sel. switch Stop PB optd.

	PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO.	PE-DM-410-145-I002
	TITLE:	DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	DATE	09.03.2015
			REV.NO.	01
			SHT	7 OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE

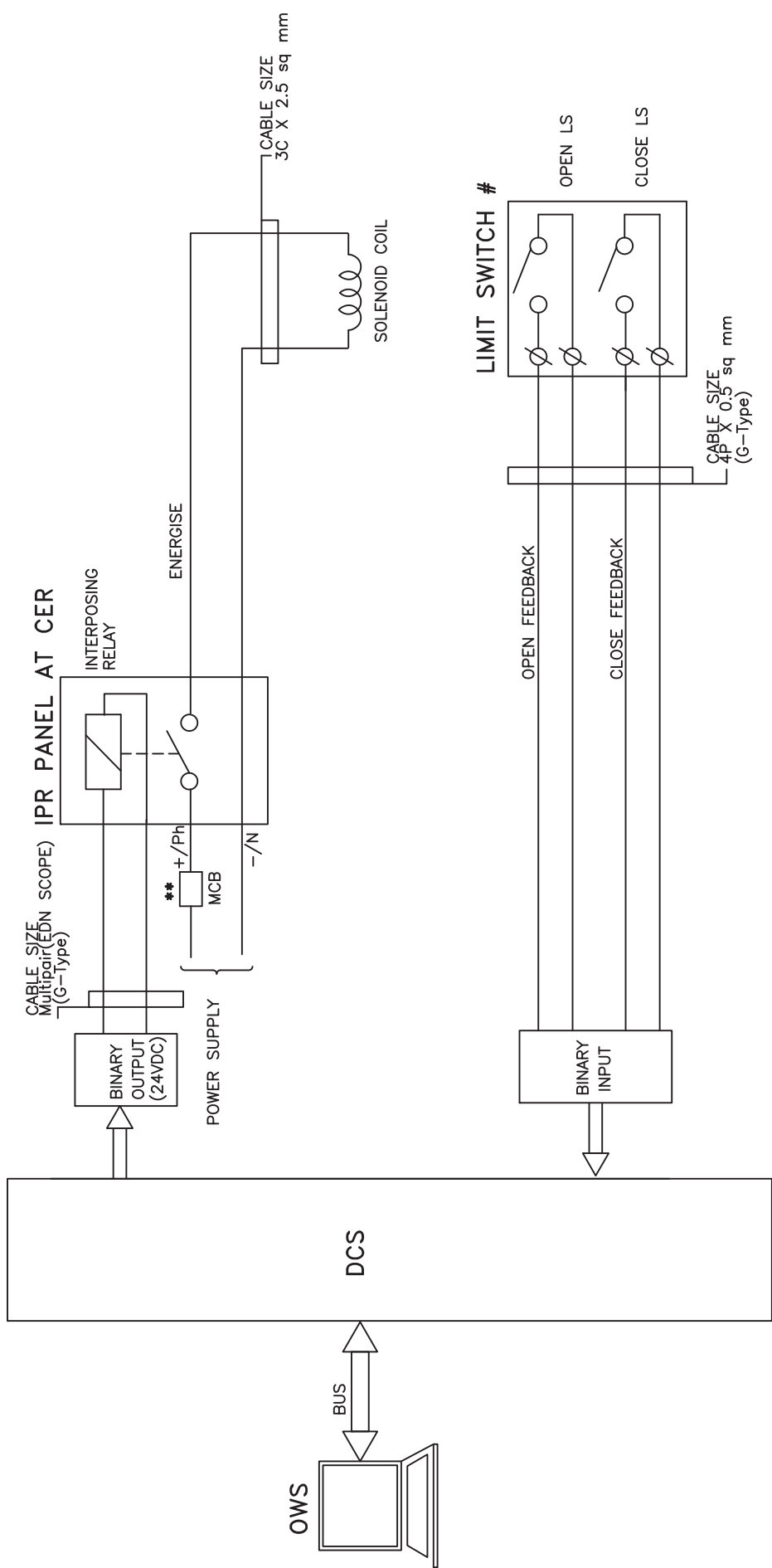


 Maharatna Company	PROJECT:		1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12		DRG.NO.	PE-DM-410-145-I002	
					DATE	09.03.2015	
	TITLE:		DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO.	01	
					SHT	8	OF

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* FOR LTUD DRIVES ALL LUBE OIL PUMPS, SCANNER AIR FANS, SEAL AIR FANS, 4-20mA CURRENT TRANSDUCER SHALL BE CONSIDERED.

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



NOTES:

- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

PROJECT:	1X800 KOTHAGUDEM TPS			DRG.NO.	PE-DM-410-145-I002
	STAGE-VII, UNIT-12			DATE	09.03.2015
TITLE:	DDCMIS INTERFACE FOR			REV.NO.	01
	SOLENOID DRIVE (SINGLE COIL)			SHT	9 OF 11



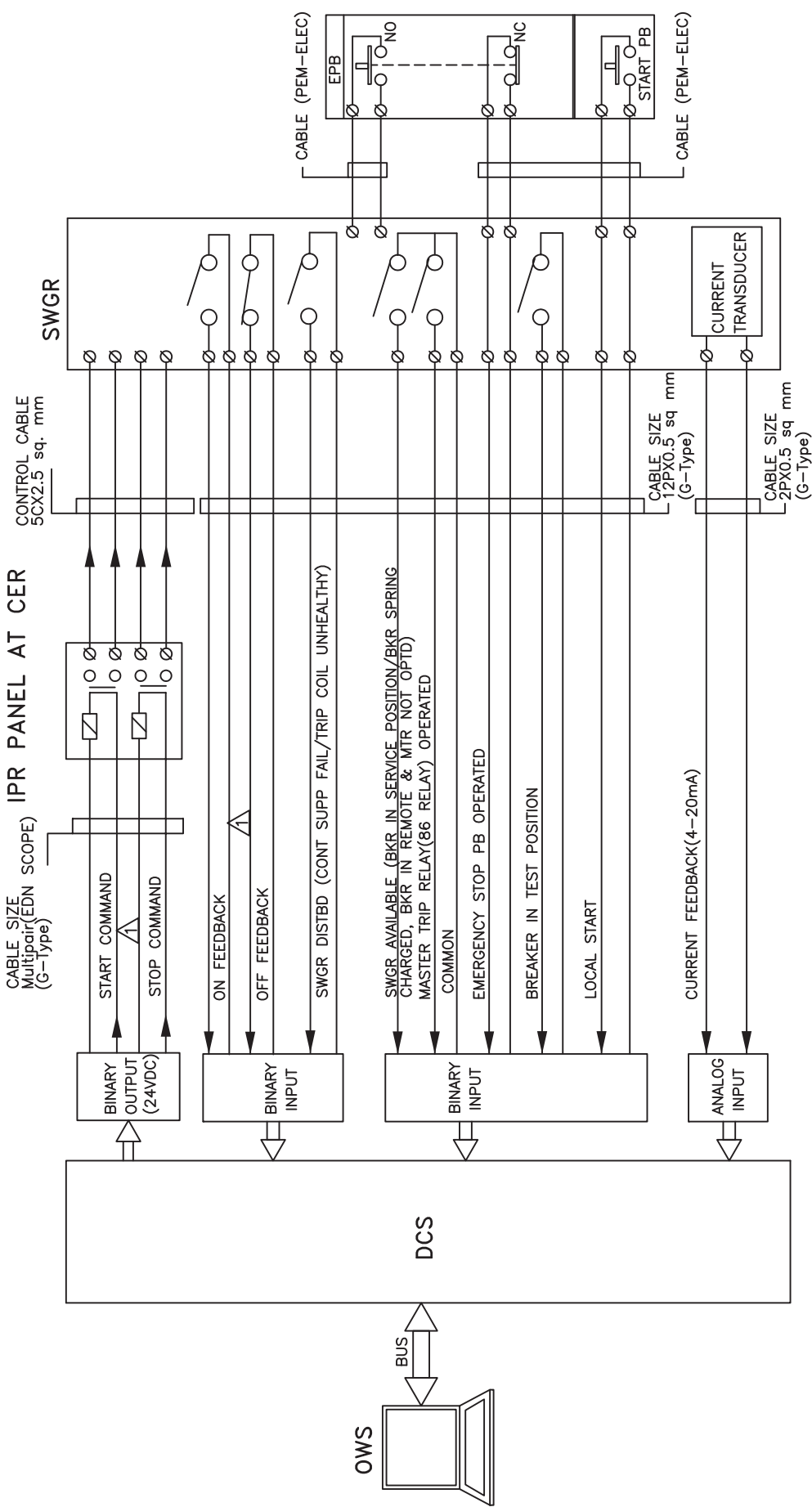
213 of 311

[illegible]

MCB SHALL BE PROVIDED FOR EACH SOLENOID
FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

 Maharatna Company	PROJECT:		1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO.	PE-DM-410-145-I002
	TITLE:		DDCMIS INTERFACE FOR SOLENOID DRIVE (DOUBLE COIL)	DATE	09.03.2015
				REV.NO.	01
				SHT	9a OF 11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



 Maharatna Company	PROJECT:	1X800 KOTHAGUEDEM TPS STAGE-VII, UNIT-12	DRG.NO.	PE-DM-410-145-I002
	TITLE:	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	DATE	09.03.2015
			REV.NO.	01
			SHT	10 OF 11



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 17.03.2015

SHEET OF

KKS PHILOSOPHY

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY
	1X800MW KOTHAGUDEM

KKS NUMBERING PHILOSOPHY

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

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

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

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

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

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

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

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY
	1X800 MW KOTHAGUDEM

ANNEXURE-1

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

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

ANNEXURE-2

Standard Equipment Codes:

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

Standard Apparatus Codes:

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



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

1X800 MW KOTHAGUDEM

Standard Measuring Circuits Codes:

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

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

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

B) Numerical keys at Equipment Code level:

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

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

N1N2 N3

DOCUMENT TITLE			
	KKS NUMBERING PHILOSOPHY		
	1X800 MW KOTHAGUDEM		
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99
ii) Field Instruments			
Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			
Example of Numerical Key Usage:			
In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.			

VOLUME : VI
SECTION-VII
SUB SECTION - E
ERECTION HARDWARES

1.00.00 GENERAL TECHNICAL REQUIREMENTS

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

However, any item required for erection of Bidder supplied system but not categorically indicated in this section, shall be supplied by the Bidder and all these items shall conform to International / National standards / codes.

1.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
 - ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
 - iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II(1981).. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel lacker or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
 - iv) All rigid conduit fittings shall conform to requirements of IS:2667,1976. Galvanized steel fittings shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fitting shall be compatible with the flexible conduit supplied.
- b) Flexible Conduit
 - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
 - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
 - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
 - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

- 1.02.00 Electrical Junction Box :
Please refer to Section VII , Subsection – D of this volume of the Specification.
- 1.03.00 Cable Gland
1. Type : Double compression
 2. Entry Thread : NPT / ET
 3. Material : Brass
 4. Finish : Cadmium Plated.
 5. Protection : IP 54 or better
 6. Accessories : Neoprene gasket, locknuts, reducers etc
- 1.04.00 Cable Tray
1. Material : Mild steel, slotted
 2. Thickness : not less than 2.0 mm
 3. Finish : Hot dip galvanized
 4. Perforation : As per MFR standard
 5. Cover : Suitable for tray
- 1.05.00 Process Hook Up Accessories & specification
Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.
- 1.05.01 Seamless Stainless Steel Pipe
1. Reference : ASTM A-312 TP 316
 2. Material Grade : TP 316
 3. Type : Seamless /Plain end
 4. Size : As applicable (e.g. NB etc)
 5. Schedule : 40
 6. Standard Length : 5 meter
- 1.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : To suit related SS pipe.
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 , ASTM A-249 or ASTM A-269
2. Material Grade : TP 316
3. Size : As applicable (e.g. OD 0.083 wall thickness / OD 0.049 wall thickness etc.)
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

1.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel

- | | | |
|---------|---------------------|---|
| | 5. Type of Fittings | : Male / female connector, elbow, cross / equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. |
| | 6. Size | : To suit SS tubing and NPT end connection |
| 1.05.05 | C.S. Pipe | |
| | 1. Reference | : ASTM-A 106 Gr. C |
| | 2. Material | : Cold drawn seamless black C.S. |
| | 3. Type | : Seamless / Plain ends |
| | 4. Size | : As applicable (e.g. NB etc) |
| | 5. Schedule | : 80, 160, S as required |
| | 6. Standard Length | : 5 meter |
| 1.05.06 | C.S. Pipe Fittings | |
| | 1. Reference | : ASTM-A 105 / ANSI B16.11 |
| | 2. Type | : Forged |
| | 3. Rating | : 3000 lbs / 6000 lbs / 9000 lbs |
| | 4. Size | : Suitable to related C.S.Pipe |
| | 5. End connection | : Generally socket weld |
| | 6. Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |
| 1.05.07 | A.S. Pipe | |
| | 1. Reference | : ASTM-A 335 P22 AS PER ANSI B 36.10 |
| | 2. Material | : Cold drawn seamless A.S. |
| | 3. Type | : Seamless / Plain ends |
| | 4. Size | : As applicable (e.g. NB etc) |
| | 5. Schedule | : S |
| | 6. Standard Length | : 5 meter |
| 1.05.08 | A.S. Pipe Fittings | |

1. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
2. Type : Forged
3. Rating : 9000 lbs
4. Size : Suitable to related A.S.Pipe
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.09

G.I.Pipe

1. Reference : IS-1239, Part-I
2. Type : Medium grade, threaded at both ends protected with end caps
3. Material : Continuous ERW galvanized MS pipe
4. General : Pipe shall be galvanized both inside and outside
5. Size : As applicable (e.g 1/2 /3/4 /1 etc.)

1.05.10

G.I.Pipe Fittings

1. Reference : IS-1239, Part-II for material, dimension, thread etc.
2. Style : Threaded
3. Type of Fittings : Equal tee, three piece union, unequal tee, straight socket, 90 Deg. elbow, reducing socket cap. etc. to suit installation.
4. Size : Suitable to related G.I.Pipe

1.05.11

Carbon Steel Globe Valve

1. Reference : ASTM A-105
2. Type : Globe
3. Construction : Forged Body Cadmium Plated
4. End Connection : As applicable (eg. Socket Weld etc.)
5. Rating : Cl. 800 / CL. 2500

- | | | |
|-----|-----------------|-----------------------------------|
| 6. | Material | : Body - Carbon steel |
| | | : Stem - Hardened Steel |
| | | : Plug - AISI 316 SS |
| | | : Seat- Stainless steel stellited |
| 7. | Packing | : Teflon / Grafoil as required |
| 8. | Yoke | : ASTM A105 |
| 9. | Hand wheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.12 Stainless Steel Globe Valve

- | | | |
|-----|-----------------|---|
| 1. | Reference | : ASTM A-182 F316 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body |
| 4. | End Connection | : As applicable (eg. Socket Weld etc.) |
| 5. | Proof Pressure | : 400 Kg/Cm ² |
| 6. | Material | : Body - Stainless steel |
| | | : Stem - Hardened Steel |
| | | : Plug - AISI 316 SS |
| | | : Seat- Stainless steel stellited |
| 7. | Packing | : Teflon as required |
| 8. | Yoke | : ASTM A182 F316 |
| 9. | Handwheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.13 Alloy Steel Globe Valve

- | | | |
|----|--------------|------------------|
| 1. | Reference | : ASTM A-182 F22 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body |

4. End Connection : As applicable (eg. Socket Weld etc.)
5. Rating : CL. 2500
6. Material : Body - Alloy steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
7. Packing : Grafoil as required
8. Yoke : ASTM A182 F22
9. Handwheel : Carbon steel
10. Design standard : As per ANSI B 16.34

1.05.14 Structural Steel

Steel supports for B's, trays tubes and related equipments shall not be limited to the following:

- a) MS Angle
- b) MS Channel
- c) I-Beam
- d) Hexagonal head Bolt & Nut with washer
- e) Foundation Bolt & Nut
- f) Expansion Bolt
- g) Steel Plates / Flats
- h) CRCA sheet
- i) 50 NB Pipe
- j) Pipe clamps, U Bolts & Nuts
- k) Checker plate

1.05.15 Condensate Pot

1. Reference : ASTM A182 F22 /ASTM A105
2. Material : Alloy steel / carbon steel as per application
3. Construction : Drilled from barstock
4. End connection : As applicable (e.g 3 nos. socket weld end etc.)

	5. Accessories	: Vent valves
1.05.16	Instrument Valve Manifold	
	1. Type	: Two valve manifold
		: Five valve manifold
	2. Mounting	: Remote 2 Pipe Mounting / Transmitter Rack mounting
	3. Construction	: Single block (bar stock)
	4. Material	: Forged body and bonnet AISI 316 stainless steel
	5. Ports	: Mfg std. (e.g 1/2 NPT (F) etc.)
	6. Rating	: 420 Kg/S . cm at ambient
	7. Operating Temperature	: (-)30 to ()170 Deg C
	8. Packing	: PTFE Wafer
	9. Seat & Stem	: AISI 316 SS
	10. Plug	: AISI 316 SS free to turn on stem / 17-4 PH
	11. Handle Bar	: AISI 316 SS
	12. Connection	: Straight
	13. Accessories	: Plugs for all ports, Mounting Bracket , bolts , nuts

1.06.00 Pneumatic Hook Up Accessories

1.07.00 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2 NPT (M)	: 1 NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2 NPT (M)	: 1/ 2 NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel

Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point

**C&I MANDATORY SPARES LIST FOR
AUXILIARY PACKAGE
FOR 1 X 800 MW KOTHAGUDEM**

S.No.	Particulars	C&I Materials			
		As per Instruments (A)	As per PLC (B)	As per Control Des / as per notes (C)	REMARKS
1	DM Cooling Water System	REFER POINT NO. A OF ANNEXURE I	NA	NA	SINCE ALL THESE SYSTEMS ARE DCS BASED , MANDATORY SPARES FOR THESE PACKAGES PERTAINING TO COLUMN NO. B & C SHALL NOT BE APPLICABLE. MANDATORY SPARES PERTAINING TO DCS SHALL BE TAKEN CARE BY EDN.
2	Online Condenser Tube Cleaning System		NA	NA	
3	Self Cleaning Filter		NA	NA	
4	CHEMICAL DOSING SYSTEM		NA	NA	
5	MILL REJECT SYSTEM (PNEUMATIC TYPE)		NA	NA	
6	Fuel Oil Handling System		NA	NA	
7	Filtered Water Transportation System(DM makeup , CW makeup, filter back wash, service water, potable water system)		NA	NA	
8	DM Transportation System(DM transfer, Storage, Boiler fill, Hotwell makeup)		NA	NA	
9	CW/ACW System		NA	NA	
10	CW TREATMENT PLANT		NA	NA	
11	CONDENSATE POLISHING UNIT		NA	NA	
12	OXYGEN DOSING SYSTEM		NA	NA	
13	PRETREATMENT PLANT & SLUDGE DISPOSAL SYSTEM	REFER POINT NO. A OF ANNEXURE I	NOT MENTIONED	NOT MENTIONED	
14	D.M. PLANT & Potable Water Treatment Plant	NOT MENTIONED	REFER POINT NO. B OF ANNEXURE I	REFER POINT NO. B OF ANNEXURE I	
15	GAS CHLORINATION PLANT(CW CHLORINATION)	NOT MENTIONED	REFER POINT NO. B OF ANNEXURE I	REFER POINT NO. B OF ANNEXURE I	
16	Waste Water Treatment System(EFFLUENT TREATMENT PLANT)	NOT MENTIONED	REFER POINT NO. B OF ANNEXURE I	REFER POINT NO. B OF ANNEXURE I	
17	AIRCONDITIONING SYSTEM & VENTILATION SYSTEM	NOT MENTIONED	NOT MENTIONED	NOT MENTIONED	
18	COMPRESSED AIR SYSTEM	REFER POINT NO. A OF ANNEXURE I	REFER POINT NO. B OF ANNEXURE I	REFER POINT NO. B OF ANNEXURE I	

NA

NOT APPLICABLE

C&I MANDATORY SPARES FOR 1 X 800 MW KOTHAGUDEM (ANNEXURE-I)			
A	Field Instruments		
1	Transmitters/ Gauges/Switches etc. along with relevant accessories		10% of total or at least two (whichever is higher) for each type along with accessories.
2	Temperature Element (RTD/Thermo-couple) with thermowell		10% of each type , range and immersion length . Minimum 5 nos.
3	Furnace Temperature Probe		Thermocouple 1 no.
B	PLC/ Proprietary Control System		
1	Network cards, Communication Interface cards		5% for each type or but minimum 1 no.
2	I/O Cards (Each type)		5% for each type but minimum 1 nos.
3	Controller Cards		2 nos.
4	SER Cards		5% for each type or but minimum 1 no.
5	All other Electronic Modules		5% for each type but minimum 1 no.
6	Relays		10% of total quantity
7	Power Supply Modules & Power Packs for control system		5% for each type and range but minimum 1 no. .
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)		10% for each type or but minimum 1 no.
9	MCB (Miniature case circuit breaker)		10% for each type or but minimum 1 no.
10	Fuses		200% each type and rating
11	Racks for housing I/O & Processor Modules		1(One) no. each type used in the system
12	Prefab interconnecting cables with connectors		10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type.
13	Network communication cable with end connectors		10% but minimum 1
14	I/O bus cables with connectors for remote I/O units		1 no. of each type & length
15	Fibre optic cable Converter / Deconverter		1 no.
16	Cooling Fans		10% but minimum 1
17	Loose Connectors		5 nos. of each type
18	Colour TFT Monitor		1 no. complete set



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

VOLUME

SECTION

REVISION 00

DATE: 03/04/2015

PAGE 1 of 1

VOLUME – II B

SECTION – C.5

PERFORMANCE GUARANTEES



COMPRESSED AIR SYSTEM PERFORMANCE REQUIREMENTS

DOCUMENT NO.: **PE-TS-410-555-A001**

VOLUME- II B

SECTION- C.5

REV. 0

SHEET 1 OF 1

1.0 PERFORMANCE REQUIREMENTS

COMPRESSED AIR SYSTEM

A) Following shall be demonstrated at shop:

- i) Capacity & discharge pressure of each compressor.
- ii) Power consumption of each air compressor at its rated duty point with its own motor.
The tests shall be demonstrated at manufacturer's work.

B) Following shall be demonstrated at site:

- i) Parallel operation of air compressor.
- ii) Pressure drop across Air Drying Plant, capacity & outlet dew point of each air drying plant.
- iii) Vibration level & noise level of each air compressor, blowers & any other rotating equipment of each air drying plant.



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

VOLUME

SECTION

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PAGE 1 of 1

VOLUME – II B

SECTION – D

STANDARD DATA SHEET FORMAT

(TO BE FILLED BY SUCCESSFUL BIDDER)

SCHEDULE-IXB/4

TECHNICAL PARTICULARS
FOR
COMPRESSED AIR SYSTEM

This pro-forma is to be filled in separately for Instrument Air and Service Air Compressors. Without these filled in sheets, offers are liable to be rejected.

1.00.00 GUARANTEED DATA

1.01.00 Compressor

- a) Capacity of each Compressor, NM³/MIN :
- b) Discharge Pressure, kg/sq.cm.(g) :
- c) Compressor efficiency (over-all) at design condition, % :
- d) Input Power at specified design capacity, (KW) :
- e) Maximum vibration at top and bottom of main bearing, (Micron) :
- f) Maximum noise level at a distance of 1 metre of the Compressor, 1 (db) :

1.02.00 Air Drying Plant

- a) Capacity of each Air Drying Plant : NM³/MIN
- b) Guaranteed dew point at the outlet throughout the operating cycle, Deg.C at 1 ata :
- c) Air Pressure drop across the drier (Max.), Kg./Sq.cm :

2.00.00 GENERAL

- 2.01.00 Manufacturer of compressor :
- 2.02.00 Manufacturer of Air Drying plant :
- 2.03.00 Model Number and Type of compressor :
- 2.04.00 Numbers of compressors offered :

2.05.00	Numbers of Air Drying Plants offered	:
3.00.00	PERFORMANCE DATA OF COMPRESSOR (To be filled in by the Bidder separately for Instrument Air and Service Air Compressors)	
3.01.00	Capacity of each compressor, NM ³ /Min	:
3.02.00	Discharge pressure, Kg/Sq.Cm (g)	
3.03.00	Design Ambient Temperature, Deg.C	:
3.04.00	Design Ambient Pressure, Kg/Sq.cm(g)	:
3.05.00	Design Ambient Relative Humidity, %	:
3.06.00	Air temperature at compressor discharge	:
3.07.00	Interstage temperature(s), Deg.C (if applicable)	:
3.08.00	Interstage Press.(s), Kg/Sq.cm(g) (if applicable)	:
3.09.00	Compression efficiency at design condition	:
3.10.00	Volumetric efficiency at design condition	:
3.11.00	Mechanical efficiency at design condition	:
3.12.00	KW input required by the compressor at rated conditions	:
3.13.00	Compressor rotor speed, r.p.m.	:
3.14.00	Drive motor speed, r.p.m.	
3.15.00	Total cooling water requirement within battery limit, pressure drop and temperature rise	: Cu.m/hr at Kg/Sq.cm(g) & MWC, Deg.C
4.00.00	CONSTRUCTION FEATURES OF AIR COMPRESSOR	
4.01.00	Number of stages	:
4.02.00	Type of drive (V belt/Gear box etc)	:
4.03.00	Jackpot cooling	:
4.03.01	Cooling by air or water	:

- | | | | |
|---------|--|---------|-----------|
| 4.03.02 | If water cooled, state cooling water requirement :
(Cu.M/hr.), temp. rise (Deg.C), pressure drop
(Kg./Sq.cm) & jacket design pressure in
Kg/Sq.cm (g) | | |
| 4.03.03 | If air cooled, state fin material and fin surface :
area in Sq.mm | | |
| 4.03.04 | Cooling Air Fans provided (if yes, indicate no. :
per Compressor, make and KW rating) | | |
| 4.04.00 | Main Bearings | | |
| 4.04.01 | Manufacturer and Model Number : | | |
| 4.04.02 | Type : | | |
| 4.04.03 | Numbers provided per Compressor : | | |
| 4.04.04 | Location : | | |
| 4.04.05 | Method of lubrication : | | |
| 4.05.00 | Lubrication | | |
| 4.05.01 | Oil pump discharge pressure, Kg/Sq. cm for :
forced feed system | | |
| 4.05.02 | Lub Oil Pump Strainer | Suction | Discharge |
| | a) Size and Filtering Media : | | |
| | b) Perforation/opening size : | | |
| 4.05.03 | All instruments, piping and valves for lube oil :
system furnished as specified? | | |
| 4.06.00 | Size and Type of Connections, mm : | | |
| 4.06.01 | Air inlet : | | |
| 4.06.02 | Air outlet : | | |
| 4.06.03 | Cooling Water inlet : | | |
| 4.06.04 | Cooling Water outlet : | | |
| 4.07.00 | Materials of Construction :
(Indicate Relevant Code) | | |

4.07.01	Compressed Chamber	:	
4.07.02	Rotors	:	
4.07.03	Inlet throttle valve	:	
4.07.04	Housing of valve	:	
4.07.05	Timing Gears	:	
4.07.06	Safety valve	:	
4.07.06	Bearing liner	:	
4.08.00	Suction Unloader :		
	a) Type and detail	:	
	b) Type of surface finish of cylinder bore	:	
4.09.00	Air Intake Filter		
4.09.01	Type and Make	:	
4.09.02	Number per compressor	:	
4.09.03	Integral/Separate Silencer provided? (Also Indicate outlet dBA)	:	Yes/No
4.09.04	Particle removal upto (Specify size)	:	
4.09.05	Efficiency in % with corresponding particle size in microns in new condition	:	
4.09.06	Filtering Media	:	
4.10.00	Air Receiver		
4.10.01	Total Number furnished	:	
4.10.02	Design Pressure, Kg/Sq.cm(g), design temperature (Deg.C) and design and fabrication Code	:	
4.10.03	Hydraulic test pressure, Kg/Sq.cm(g)	:	
4.10.04	Water Capacity each, Cu.m	:	
4.10.05	Material of construction	:	

4.10.06 Dimensions and Weight :

- a) Diameter, mm :
- b) Height/length on straight, mm :
- c) Shell thickness, mm :
- d) Type of dished end/dimension :
- e) Thickness of dished end, mm :
- f) Air inlet/Outlet size, mm :
- g) Drain size, mm :
- h) Manhole/hand hole size, mm :
- i) Weight, Kg :

4.10.07 All connections, valves, traps, instruments, supporting stands etc. furnished as specified? : Yes / No

4.10.08 Inter coolers, After Coolers and Moisture Separators : Intercooler Aftercooler

- a) Number per Compressor offered :
- b) Design and fabrication Code :
- c) Air Cooled/Water Cooled & corresponding flow rate, Cu.m/hr :
- d) Heat Exchanger Capacity, Kcal/hr :
- e) Design Pressure, Kg/Sq.cm (g) :
 - i) Shell :
 - ii) Tube :
- f) Temperature, Deg.C:
 - i) Compressed Air Inlet :
 - ii) Compressed Air Outlet :
 - iii) Cooling Air/Water Inlet :

- iv) Cooling Air/Water Outlet :
- g) Pressure Drop, mwc :
 - i) Cooling air/water side :
 - ii) Compressed air side :
- h) Effective heat transfer area, Sq.m :
- i) Shell OD x thk, mm x mm :
- j) Tube OD x thk, mm x mm :
- k) Overall length, m : Intercooler Aftercooler
- l) Size and Type of Connections :
 - i) Compressed Air Inlet :
 - ii) Compressed Air Outlet :
 - iii) Cooling Water Inlet :
 - iv) Cooling Water Outlet :
 - v) Drain :
- m) Materials of Construction
 - i) Tube :
 - ii) Shell :
 - iii) Tube sheet :
 - iv) Baffles :
- n) Moisture Separator
 - i) Number per Compressor offered :
 - ii) Moisture content of air at separator :
inlet and outlet, Kg/Cu.m of free air
 - iii) Necessary relief valve, level gauge, :
trap station etc. furnished as specified

5.00.00	DESIGN AND CONSTRUCTION FEATURES (Air Drying Plant)			
5.01.00	General	:		
5.01.01	Manufacturer	:		
5.01.02	Model No. and type	:		
5.01.03	Weight of complete unit, Kg	:		
5.02.00	Guaranteed Performance			
5.02.01	Capacity	:		
5.02.02	Rated flow, Nm ³ /min of free air	:		
5.02.03	Short duration peak flow, Nm ³ /min of free air : (indicate period also)	:		
5.03.00	Guaranteed dew point at the outlet throughout : the operating cycle (at operating pressure)	:		
5.04.00	Moisture Content of Air, gms/m ³ /min	:		
5.04.01	At dryer inlet	:		
5.04.02	At dryer outlet	:		
5.05.00	Air pressure drop between the battery limits, : Kg/cm ²	:		
5.06.00	Total power consumption of the plant KW	:		
5.07.00	Design and Construction Features			
5.07.01	Heat Exchangers	Pre- filter	Evapor- ator	Refrigerant condenser
	a) Manufacturer & Model No.	:		
	b) Type and code of construction	:		
	c) No. of passes	:		
	d) Shell side fluid media	:		
	i) Design flow, m ³ /min	:		

- ii) Inlet temp, °C :
- iii) Outlet temp, °C :
- iv) Design fouling factor, hr.m² °C/Kcal :
- v) Velocity, m/sec. :
- e) Tube Side Fluid Media :
- i) Design flow, m³ /min :
 - ii) Inlet temp, °C :
 - iii) Outlet temp, °C :
 - iv) Design fouling factor, hr.m² °C/Kcal
 - v) Velocity, m/sec
- f) Heat exchange capacity, Kcal/hr. :
- g) Heat transfer surface area, m² :
- h) L.M.T.D., °C (Including correction factor) :
- i) Overall heat transfer co-efficient, Kcal /hr. m² °C :
- j) Normal working pressure, Kg/ cm² (g) :
- k) Design pressure, Kg/ cm² (g) :
- l) Test pressure, Kg/ cm² (g) :
- m) Pressure drop, Kg/ cm² :
- n) Design temp. °C :
- o) Testing temp. °C :
- p) Constructional Feature :
- i) Tubes
 - Material :
 - Quantity, Nos. :

- Outside Dia, mm :
 - Thickness, mm :
 - Special feature, if any :
- ii) Shell
- Material :
 - O.D., mm :
 - Thickness, mm :
 - Special feature, if any :
- iii) End plates
- Material :
 - Outside Dia., mm :
 - Thickness, mm :
 - Special feature, if any :
- iv) Baffles (Cross)
- Type :
 - Quantity, Nos. :
 - Material :
 - Thickness, mm :
 - Special feature, if any :
- v) Baffles (Long)
- Type :
 - Quantity, Nos. :
 - Material :
 - Thickness, mm :
 - Special feature, if any :

vi) Channel

- Type :
- Thickness, mm :
- Special feature, if any :

vii) Gaskets

- Quantity, Nos. :
- Material :
- O.D./ mm :
- Thickness, mm :

viii) Nozzles

- Quantity, Nos. :
- N.B., mm :
- Thickness, mm :
- Special feature, if any :

ix) Any other items :

x) Auxiliaries provided

- Vent connection with valve (specify size) :
- Drain connection with valve (specify size) :
- Relief valve :
- Other auxiliaries :

q) Overall dimension (mm) & wt. (kg) :

5.07.03 Refrigerant Compressor

- a) Manufacturer and Model No. :
- b) Type :

- c) Capacity, Kcal/hr :
- d) RPM :
- e) No. of Cylinders :
- f) Bore, mm :
- g) Stroke, mm :
- h) Condensing temperature, °C :
- i) Evaporating temperature, °C :
- j) B.H.P. Required :
- k) H.P. Recommended :
- l) Overall dimension (mm) & wt. (kg) :

5.07.04 Moisture Separator

- a) Manufacturer & Model No. :
- b) Type :
- c) Constructional features in details
(with materials of construction) :
- d) Auxiliaries provided :
 - Vent connection with valve
(Specify size, mm) :
 - Drain connection - type & size :
 - Other auxiliaries :
- e) Overall dimension (mm) & weight (Kg) :

5.07.05 Filter

- a) Manufacture & Model No. :
- b) Nos. per plant :
- c) Design free air flow, M³/min. :

- d) Filter Media :
- e) Minimum pressure drop, Kg/cm² :
- f) Maximum pressure drop, Kg/cm² :
- g) Design Pressure, Kg/cm² (g) :

5.07.06 Insulation

- a) Items insulated & insulation thickness (mm) :
- b) Material and Code :
- c) Manufacturer :
- d) Insulation surface temperature Deg.C :

5.07.07 Piping

- a) Material Code and Manufacturer :
- b) Sizes offered :
- c) Type of joints :
- d) Velocity of fluid in pipes :
- e) Design Pressure, Kg/Sq.cm(g) :

5.07.08 Valves

- a) Materials of Construction :
- b) Manufacturer :
 - i) Gate Valve :
 - ii) Globe Valve :
 - iii) Check Valve :
 - iv) Ball Valve :
 - v) Relief Valve :
 - vi) Solenoid Valve :
 - vii) Others, if any :

- 5.07.09 Strainers :
- a) Manufacturer and Model No. :
 - b) Nos. Per plant :
 - c) Design flow, NM³ /Min :
 - d) Maximum pressure drop, Kg/cm² :
 - e) Design pressure, Kg /cm² (g) :
 - f) All valves, instruments & connections as per specification furnished? : Yes
- 5.07.10 Traps :
- a) Manufacturer and Type :
 - b) Material of construction :
 - c) Complete Piping, valves and Instruments furnished as specified and shown in tender drawing? :
- 5.07.11 In-line strainers :
- a) Type :
 - b) Body & screen material :
- 5.07.12 Sight Flow Indicators :
- a) Type :
 - b) Material of construction :
- 5.07.13 All operating/safety controls and interlocks as specified/required provided? :
- 5.08.00 Control And Instrumentation :
- 5.08.01 Control Panel :
- a) Make and number furnished per plant :
 - b) Overall dimension each (mm) :

- c) Panels internally wired & complete with all :
control, interlock, annunciation and
instruments as specified?
- 5.08.02 Control write-up & schematic drawing furnished? :
- 5.08.03 Selector Switch
 - a) Make and Model No. :
 - b) No. Per panel :
 - c) Current rating :
- 5.08.04 Timer
 - a) Make and Model No :
 - b) No. Per panel :
 - c) Adjustable range :
 - d) Accuracy class :
- 5.08.05 Annunciation System
 - a) No. of windows per panel :
 - b) Make and type :
- 5.08.06 Push Buttons
 - a) Make and Model No :
 - b) No. Per panel :
 - c) Contact rating :
- 5.08.07 Control Wiring
 - a) Voltage class and size :
 - b) Insulation :
- 5.08.08 Terminal Blocks
 - a) Make and Catalogue No. :
 - b) Voltage grade and current rating :

	c) Suitable for copper cable size	:			
	d) 20% spare terminals furnished?	:			
5.08.09	Cable between Panel & Equipment				
	a) Voltage class and size	:			
	b) Insulation	:			
5.08.10	Panel Illumination	:			
	a) Type and Make of lamps	:			
	b) Voltage and total wattage	:			
5.08.11	Indicating Lamps				
	a) Make and type	:			
	b) Voltage and wattage each	:			
5.08.12	Instruments		Pressure Indicator	Pressure Switch	Temp. Indicator
	a) Type and make	:			
	b) Range and No. offered	:			
	c) Dial size, mm	:			
	d) No. of contacts & contact rating of switches	:			
	e) Instruments mounted on local panel to isolate vibration?	:			
6.00.00	PIPING		Comp. Air	Cooling water and drain piping	
				Yes	No
6.01.00	Material Code and Manufacturer	:			
6.02.00	Sizes offered	:			
6.03.00	Type of joints	:			
6.04.00	Velocity of fluid in pipes considered	:			
6.05.00	Design Pressure, Kg/Sq.cm(g)	:			

- 6.06.00 All piping, valves, pipe supports, fittings, connections, instruments and all other accessories as specified and as required, furnished? :
- 6.07.00 Insulation
- 6.07.01 Items insulated :
- 6.07.02 Material and Code :
- 6.07.03 Insulation Surface temperature, Deg.C :
- 6.07.04 Outer Cover, material & thickness :
- 6.08.00 Valves
- 6.08.01 Material of valves in air lines :
- i) For sizes 50 mm and below :
 - ii) For sizes above 50 mm :
- 6.08.02 Material of valves in cooling water & drain lines :
- i) For sizes 50 mm and above :
 - ii) For sizes upto 50 mm :
- 6.08.03 Relief Valves
- a) Manufacturer :
 - b) Type, Code/Standard :
 - c) Number offered corresponding to each equipment with set pressure, design pressure, test pressure, relieving capacity & material of construction of body & springs shall be furnished in a tabular format. :
- 6.08.04 Gate Valves
- a) Make :
 - b) Code/Standard :
 - c) Material (specify standard /code) :

- i) Body :
 - ii) Trim :
- d) Type of ends :
- 6.08.05 Globe Valves
 - a) Make :
 - b) Code/Standard :
 - c) Material of body and trim (specify standard/ code) :
 - d) Type of ends :
- 6.08.06 Check Valves
 - a) Type :
 - b) Make :
 - c) Code/Standard
 - d) Material of Body, Spring, flap (specify : standard/code)
 - e) Type of ends :
- 6.08.07 Ball Valves
 - a) Make :
 - b) Type :
 - c) Code and standard :
 - d) Material of body and ball (specify standard/ code) :
- 6.08.08 Solenoid Valves
 - a) Make :
 - b) Type :
 - c) Material of body and trim (specify : standard/code)

	d) Contact rating	:	
6.08.09	Sight Flow Indicators		
	a) Make	:	
	b) Type	:	
	c) Material of construction (specify standard/ code)	:	
6.08.10	Traps		
	a) Manufacturer and Type	:	
	b) Material of construction (specify standard/ code)	:	
6.08.11	Strainer		
	a) Type and Make	:	
	b) Material of construction (specify standard/code)	:	
	i) Body	:	
	ii) Screen (mesh size)	:	
7.00.00	COMPRESSOR CONTROL SYSTEM		
7.01.00	Write-up on the system enclosed		Yes/No
7.02.00	Compressor operating pressure ranges for :		
	i) ON/OFF control	:	
	ii) 50% load-unload control	:	
	iii) 100% load-unload control	:	
7.03.00	Adjustable range	:	
8.00.00	DRIVE DETAILS		
8.01.00	Details of drive motors as per enclosed proforma furnished in Volume IIIC?	:	Yes/No

- 8.02.00 Make and Type/model no. of V-belt/ Gear box :
etc. and corresponding design code/standard
- 8.03.00 Necessary guards furnished ? :
- 8.04.00 Nos. of starts/hr. :
- 9.00.00 WEIGHTS
- 9.01.00 Each compressor assembly, kg. :
- 9.02.00 Drive, Kg. :
- 9.03.00 Complete weight of each Air Drying Plant :
Assembly on Base Frame, Kg.



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

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ANNEXURE – I

**COMPLIANCE CUM CONFIRMATION
CERTIFICATE**



TITLE:

**TECHNICAL SPECIFICATION
1 X 800 MW KOTHAGUDEM TPS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPEC. NO.: PE-TS-410-555-A001

VOLUME: III

ANNEXURE-I

REV. NO. 0 DATE

SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

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

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.



TITLE:

**TECHNICAL SPECIFICATION
1 X 800 MW KOTHAGUDEM TPS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

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ANNEXURE-I

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



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**VOLUME – III
ANNEXURE – II
SUB-VENDOR LIST**

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

S.NO.	DESCRIPTION OF EQUIPMENTS	APPROVED SUB-VENDORS
1.	OIL FREE SCREW COMPRESSOR	ATLAS COPCO - PUNE KOBELCO (KPC) – PUNE ELGI – COIMBTORE Ingersoll Rand - Ahmadabad
2.	AIR DRYING PLANT (HOC TYPE -ROTARY DRUM)	ATLAS COPCO – PUNE KOBELCO – JAPAN
3.	AIR DRYING PLANT (HOC TYPE – CONVENTIONAL TWIN TOWER)	MELLCON – DELHI DELAIR – GURGAON SUMMITS – COIMBTORE Shalkot- Noida
4.	AIR DRYING PLANT (REFRIGERANT TYPE)	ATLAS COPCO - PUNE, SUMMITS - COIMBTORE DELAIR - GURGAON SAVROE - GERMANY MTA - ITALY DOMNIC HUNTER - UK SHALKOT - Noida
5.	AIR RECEIVER	PARKAIRE – DELHI ARC WELD – BARODA HEAT TRANSFER – PUNE UNITED ENGG. WORKS – NASIK AIROX-NIGEN - AHMEDABAD. TEMASME VESSELEX – NOIDA.
6.	AIR FILTERS	IAEC - FINE FILTERS -
7.	INSULATION MATERIAL	FGP - LLOYDS - BASF - METTUR BEARDSHELL - U.P.TWIGA -
8.	PIPES (MS/GI)	TATA TUBE - JAMSHEDPUR JINDAL - GHAZIABAB SAIL - ROURKELA SURYA ROSHNI – BAHADUR GARH
9.	PIPES (STAINLESS STEEL)	REMI - MUMBAI RATNAMANI - AHMEDABAD CHOKSI - AHMEDABAD
10.	PIPE FITTINGS	MS FITTINGS – KOLKATTA METAL LLOYDS – MUMBAI BHARAT FORGE – PUNE TUBE PRODUCTS – BARODA NITIN PROFILE - BARODA
11.	BEARINGS	SKF - NORMA - FAG - NBC -

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

12.	AUTO DRAN TRAPS (INVERTED BUCKET/ BALL FLOAT TYPES)	DRAYTON - GREAVES - JN MARSHALL (SPIRAX) - PUNE
13.	ELECTRONIC DEW POINT METER	SHAW - GE SENSING -
14.	CAST STEEL GATE/GLOBE/NON-RETURN VALVES	FLUIDLINE VALVES - MUMBAI CRESCENT – NAVI MUMBAI LEADER – JALANDHAR AV VALVES – AGRA FOURESS VALVES – MUMBAI KBL – PUNE NITON INDUSTRIES – MUMBAI STEEL STRONG – NAVI MUMBAI VENUS – KOLKATTA BDK ENGG. – HUBLI (KARNATAKA)
15.	GUN METAL GATE/GLOBE/NON RETURN VALVES	LEADER – JALANDHAR AV VALVES – AGRA SANT VALVES - JALANDHAR
16.	BALL VALVES	CRESCENT – NAVI MUMBAI BDK – HUBLI (KARNATAKA) MICROFINISH – HUBLI (KARNATAKA)FISHER SANMAR – CHENNAI- CLASS 150/300,SIZE 15-200 NB, CCS,SH A216 Gr.WCB & CSS AV VALVES – AGRAKBL – PUNE FOR CARBON STEEL BALL VALVES ONLY. FLUIDLINE VALVES - MUMBAI FLOW CHEM - AHMEDABAD M/S AKAY INDUSTRIES PVT.LTD M/S BELGAUM AQUA VALVES PVT.LTD. M/S ASIAN INDUSTRIAL VALVES & INSTRUMENTS, CHENNAI M/S CHEMTECH INDUSTRIAL VALVES PVT. LTD. M/S DEMBLA VALVES LTD. M/S LEADER VALVES LTD.
17.	SAFETY RELIEF VALVES	BLISS ANAND – LEADER – JALANDHAR JN Marshall (SPIRAX) – PUNE KEYTONE - BARODA
18.	Pressure Gauge & DPS	M/S DRESSER INDUSTRIES INC., USA M/S GENERAL INSTRUMENTS CONSORTIUM M/S INDFOS INDUSTRIES LIMITED,GHAZIABAD M/S SWITZER INSTRUMENT LTD. M/S SOR INC., USA M/S VASU TECH LIMITED
19.	Transmitters	M/S BRISTOL BABCOCK LTD.,U.K M/S BIRLA KENT-TAYLOR LTD. M/S BLISS ANAND PVT.LTD. M/S EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD. M/S SIEMENS LTD M/S SBEM PVT.LTD.,PUNE M/S SMART INSTRUMENTS LTD, BRAZIL M/S TATA HONEYWELL LTD

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

		M/S V. AUTOMAT & INSTRUMENTS (P) LTD.
20	Temperature gauge	M/S A.N.INSTRUMENTS PVT.LTD M/S BUDENBERG GAUGE CO.LTD, UK M/S DRESSER INDUSTRIES INC., USA M/S FORBES MARSHALL (HYD) LTD. M/S GOA INSTRUMENTS INDUSTRIES PVT.LTD M/S GOA THERMOSTATIC INSTRUMENTS PVT.LTD.,GOA M/S H. GURU INSTRUMENTS (N. I.) PVT. LTD. M/S WAAREE INSTRUMENTS LIMITED,MUMBAI
21	Temperature Switch	M/S INDFOSS (INDIA) LTD. M/S DRESSER INDUSTRIES INC., USA M/S SWITZER INSTRUMENT LTD. M/S SOR INC., USA M/S TOSHNIWAL BROTHERS (P) LTD. M/S VASU TECH LIMITED
22	Control valve	M/S DeZURIK - COPEL VULCAN LTD., U.K M/S CONTINENTAL VALVES LTD. M/S CONTROL COMPONENT INC., USA M/S DRESSER VALVE INDIA PVT.LTD M/S FOURESS ENGG.INDIA LTD. M/S FISHER SANMAR LIMITED M/S FORBES MARSHALL ARCA PVT.LTD. ,PUNE - ENLISTED FOR CONTROL VALVES UPTO 12" SIZE AND ANSI RATING UPTO CLASS 1500 ONLY. M/S WEIR VALVES & CONTROLS M.E M/S INSTRUMENTATION LTD M/S KOSO FLUID CONTROLS (PVT.) LTD. M/S LESLIE CONTROLS, INC. M/S MIL CONTROLS LTD. M/S R.K.CONTROL INSTRUMENTS PVT.LTD
23	220V DC Ni-Cd BATTERIES	M/S HOPPECKE BATTERIEN GMBH & CO .KG , GERMANY M/S AMCO SAFT INDIA LTD M/S HBL POWER SYSTEMS LTD
24	220V DC LEAD ACID BATTERIES (TUBULAR AND PLANTE	M/S HOPPECKE BATTERIEN GMBH & CO .KG , GERMANY M/S EXIDE INDUSTRIES LTD M/S HBL POWER SYSTEMS LTD
25	Battery & Battery Charger	M/S AFCO INDUSTRIAL AND CHEMICALS LTD. M/S AMCO SAFT INDIA LTD M/S AMARA RAJA POWER SYSTEMS PVT. LTD- 220V/ 24V & UPTO 1000Amps M/S BCH ELECTRIC LIMITED. UPTO 250A HOUR CAPACITY ONLY M/S EXIDE INDUSTRIES LTD- LEAD ACID BATTERIES ONLY. M/S HBL POWER SYSTEMS LTD
26	LOCAL CONTROL PANELS	M/S CONTROL & SWITCHGEAR CO. LTD. M/S INDUSTRIAL CONTROLS & APPLIANCES P.LTD M/S PYROTECH ELECTRONICS PVT.LTD M/S PROCON INSTRUMENTATION PVT LTD
27	JUNCTION BOX	M/S AJMERA INDUSTRIAL & ENGINEERING WORKS- APPROVED FOR GALVANIZED AND FRP JUNCTION BOXES M/S BALIGA LIGHTING EQUIPMENTS PRIVATE LIMITED , CHENNAI M/S DEVI POLYMERS,CHENNAI M/S ELECTROMAC INDUSTRIES,MUMBAI M/S K.S.INSTRUMENTS PVT.LTD.,BANGALORE

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

		M/S MANISHA ENTERPRISE , PUNE M/S SHRENIK & COMPANY M/S SUCHITRA INDUSTRIES , BANGALORE
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**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
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VOLUME – III

ANNEXURE – III

AUXILIARY POWER CONSUMPTION

1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,						
Guaranteed Power Consumption For Air Compressor System Shall be as per Following :						
S.No. (1)	Description of Equipments (2)	Nos. of Equipments (3)		Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)	Duty Factor (5)	Total (KW) (6) = (3A)*(4)*(5)
		Working (3A)	Standby (3B)			
1	Serve Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2 pressure	2	1		0.5	
2	Instrument Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2	2	1		0.5	
3	Air Drying Plant Unit (Refrigerant type)	2	1		0.5	
					TOTAL	
Note :						
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is 540 KW (For station)					
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) including power for control panel as furnished in guaranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.					
3	The price quoted by the bidder shall be loaded @ (INR)200000/- for every additional kW increase in consumption from the base figure indicated at Note no. 1.0 above.					
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption) on actual performance testing at the manufacturing works / site, penalty @ (INR)200000/- per kW increase in power consumption figure shall be levied.					



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ANNEXURE – IV
ELECTRICAL LOAD DATA**

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.	CONTRO L 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
Instrument air Compressors	300 KW		S	2	1	C	U	N	C		Compressor House							
Service air Compressors	300 KW		S	2	1	C	U	N	C		Compressor House							
Instrument air compressor fan motor (if required separate power supply)	2.2 KW		S	2	1	D	U	N	C		Compressor House							
Service air compressor fan motor (if required separate power supply)	2.2 KW		S	2	1	D	U	N	C		Compressor House							
Instrument air compressor panel	3 KW		S	2	1	E	S	N	C		Compressor House							
Service air compressor panel	3 KW		S	2	1	E	S	N	C		Compressor House							
Instrument air Compressors motor space heater	0.15 KW		S	2	1	E	D	N	I		Compressor House							
Instrument air Compressors motor space heater	0.15 KW		S	2	1	E	D	N	I		Compressor House							
AIR DRYER PLANT PANEL	2 KW		S	2	1	D	S	N	C		Compressor House							
AIR DRYER PLANT MOTOR	9 KW		S	2	1	D	U	N	C									
AUTO DRAIN TRAP	0.3 KW		S	7	-	E	S	N	I		6 nos. at Compressor House & 1 unit receiver at TG build.							
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.		410		ORIGINATING AGENCY		PEM (ELECTRICAL)									
			PROJECT TITLE		1X800 MW KOTHAGUDEM TPS		NAME		DATA FILLED UP ON									
			SYSTEM		COMPRESSED AIR SYSTEM		SIGN.		DATA ENTERED ON									
			DEPTT. / SECTION		MAX 267 of 311		SHEET 1 OF 2		REV. 00		DE'S SIGN. & DATE							

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME Y5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTRO L 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
Any other power supply as required by bidder			To be filled by bidder															
Note: 1. Bidder to confirm that the system provided by them would be catered by the above loads considered by BHEL. In case there is any variation, the same should be clearly stated in the technical offer. No changes would be admissible during detailed engineering stage. 2. Bidder to note that for the system being supplied by them, only the above loads will be provided. In case any other load is required the same would be derived / multiplied by bidder on their own from these feeders only.																		
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 (CONTACTOR CONTROLLED)																		
LOAD DATA (ELECTRICAL)	JOB NO.		410		ORIGINATING AGENCY		PEM (ELECTRICAL)											
	PROJECT TITLE		1X800 MW KOTHAGUDEM TPS		NAME		DATA FILLED UP ON											
	SYSTEM		COMPRESSED AIR SYSTEM		SIGN.		DATA ENTERED ON											
	DEPTT. / SECTION		MAX 268 of 311		SHEET 2 OF 2		REV. 00 DE'S SIGN. & DATE											



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ANNEXURE – V
MASTER DRAWING LIST**



1 X 800 MW KOTHAGUDEM TPS
COMPRESSED AIR SYSTEM

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CUSTOMER

TSGENCO

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ANNEXURE - V

REV

00

MASTER DRAWING LIST

S.NO	DRG./DOCUMENT NO.	DRG_TITLE	Submission date
1	PE-V0-410-555-A001	Quality Plan of Air Compressor	4 weeks from the date of LOI
2	PE-V0-410-555-A002	Quality Plan for Air Drying plant	4 weeks from the date of LOI
3	PE-V0-410-555-A003	Quality Plan for Air Receiver	4 weeks from the date of LOI
4	PE-V0-410-555-A004	Quality Plan for Motor	4 weeks from the date of LOI
5	PE-V0-410-555-A005	TDS for instrument air and service air compressors	4 weeks from the date of LOI
6	PE-V0-410-555-A006	TDS for air drying plant	4 weeks from the date of LOI
7	PE-V0-410-555-A007	TDS & Characteristic Curves of Motor for Air Compressor	4 weeks from the date of LOI
8	PE-V0-410-555-A008	TDS and GA of Valves	6 weeks from the date of LOI
9	PE-V0-410-555-A009	TDS of Pipes & fitting	
10	PE-V0-410-555-A010	TDS of Instruments	6 weeks from the date of LOI
11	PE-V0-410-555-A011	GA Drawing of Instrument and Service Air Compressors	4 weeks from the date of LOI
12	PE-V0-410-555-A012	GA Drawing of Air Drier Plant	4 weeks from the date of LOI
13	PE-V0-410-555-A013	GA Drawing of Motor	4 weeks from the date of LOI
14	PE-V0-410-555-A014	GA Drawing of Air receiver	4 weeks from the date of LOI
15	PE-V0-410-555-A015	Compressor House Layout	4 weeks from the date of LOI
16	PE-V0-410-555-A016	P & ID of Instrument And Service Air Compressors	4 weeks from the date of LOI
17	PE-V0-410-555-A017	P & ID of Air Drier Plant	4 weeks from the date of LOI
18	PE-V0-410-555-A018	P & ID of Compressed air system inside Compressor House	4 weeks from the date of LOI
19	PE-V0-410-555-A019	Operation and control Philosophy of Compressed air system	6 weeks from the date of LOI
20	PE-V0-410-555-A020	Electrical & Internal Wiring Diagram for Compressor Panel	4 weeks from the date of LOI
21	PE-V0-410-555-A021	Electrical Feeder List	4 weeks from the date of LOI
22	PE-V0-410-555-A022	Control Cable Schedule	6 weeks from the date of LOI
23	PE-V0-410-555-A023	PG Test Procedure for Compressed Air System	8 weeks from the date of LOI
24	PE-V0-410-555-A024	O & M Manual for Compressed Air System	10 weeks from the date of LOI
25	PE-V0-410-555-A025	Quality Plan of Instruments for Compressed Air System	4 weeks from the date of LOI
26	PE-V0-410-555-A027	Quality Plan of Bought out items (BOI) for Compressed Air System	4 weeks from the date of LOI
27	PE-V0-410-555-A029	Sub vendor list with Inspection categorization plan	2 weeks from the date of LOI

NOTE: ANY OTHER DRAWING / DOCUMENT REQUIRED DURING DETAIL ENGINEERING SHALL BE PROVIDED BY SUCCESSFUL BIDDER WITHOUT ANY COMMERCIAL / TECHNICAL IMPLICATION



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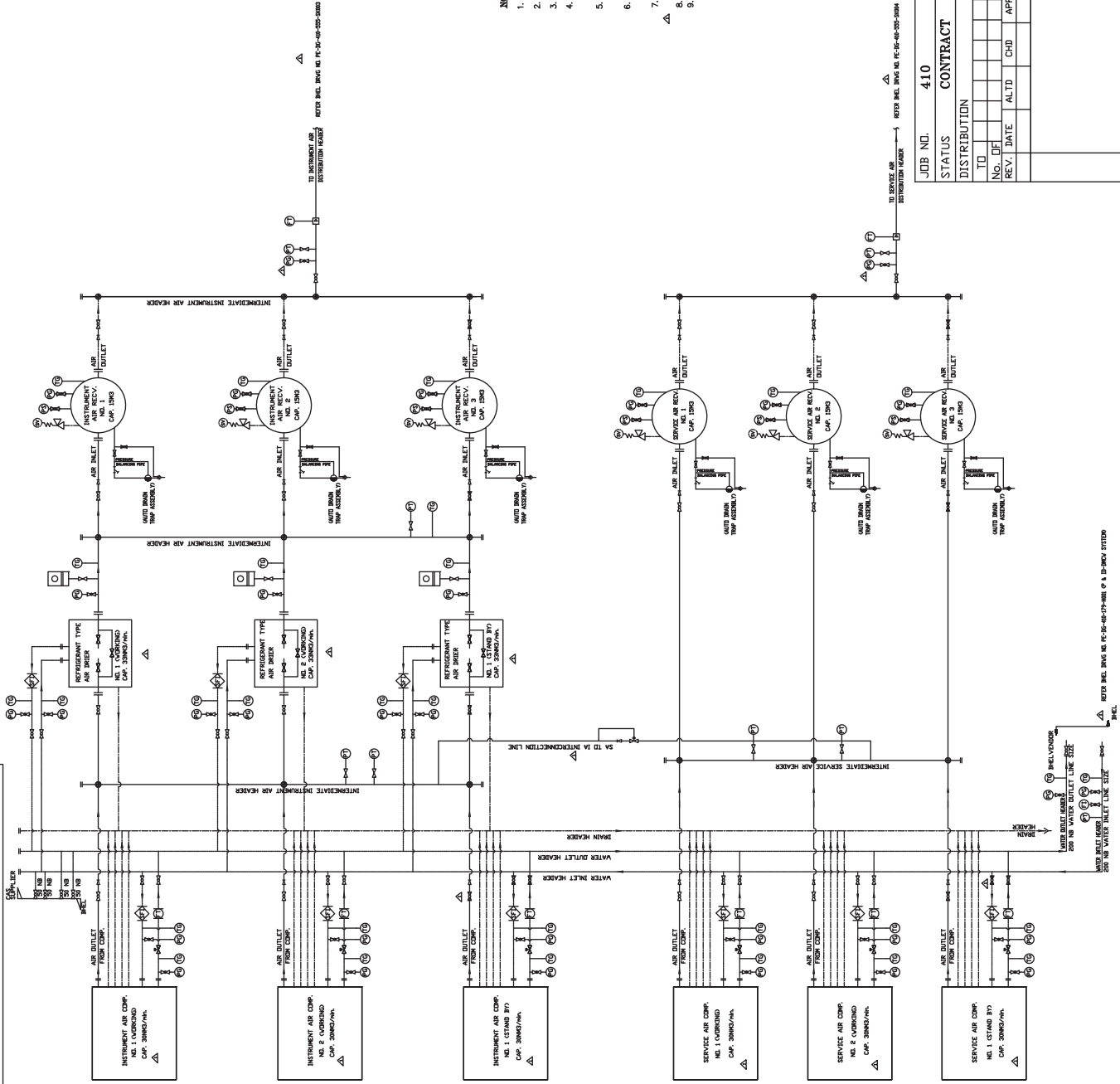
VOLUME – III

ANNEXURE – VI

REFERENCE DRAWINGS FOR TENDER ESTIMATION PURPOSE

SNO	DESCRIPTION	DRG NO
1	PLOT PLAN	PE-DG-410-100-M001
2	TG HALL EQUIPMENT LAYOUT PLAN AT 0.0M	PE-DG-410-100-M003
3	TG HALL EQUIPMENT LAYOUT PLAN AT 8.5M	PE-DG-410-100-M004
4	TG HALL EQUIPMENT LAYOUT PLAN AT 17M	PE-DG-410-100-M005
5	PID 's FOR IA & SA SYSTEM	PE-DG-410-555-SK001
6	COMPRESSOR HOUSE LAYOUT	PE-DG-410-555-SK002

DRAWING NO. PE-DG-410-555-SK001



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**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

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ANNEXURE – VII

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**TECHNICAL SPECIFICATION FOR
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ANNEXURE – VIII

LIST OF COMMISSIONING SPARES

ANNEXURE- VIII

1 X 800 MW KOTHAGUDEM TPS, STAGE-VII, UNIT-12

LIST OF COMMISSIONING SPARES (Required for Commissioning of Compressed Air System)

Break up price for COMMISSIONING SPARES

Sl. no	Description	Qty.	Unit	Unit price	Total Ex-Works Prices duly packed	ED	CST	FREIGHT Inclusive Service Tax	Total price FOR SITE
	TC (K type)	2 Nos							
	RTD (Pt 100)	2 Nos							
	Pressure Transmitters	3 Nos							
	Diff Pressure Transmitters	3 Nos							
	DIN type Temp transmitters	4 Nos							
	Control Valve								
	a. One pair of gaskets for each valve								
	a. One set of packing for each valve								
	Oil (To be supplied for all 5 compressor)	1 Lot							
	Lube Oil Filter (1 set for each compressors)	5 Sets							
	Air Filters (1 set for each compressors)	5 Sets							
	Total (Rs)								

NOTE -

1. The items indicated in the above list are minimum. Any other spares if required shall be included by bidder in the above list.
2. Bidder shall furnish unit price of commissioning spares in above format alongwith the Bid. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost.
3. Bidder to note that the items indicated in the above list shall be provided prior to commissioning of the Compressed air System. Further, items indicated in the list shall be supplied over and above the consummables that is supplied along with the compressors/compressed air system prior to start up.



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ANNEXURE – IX

LIST OF MANDATORY SPARES

MANDATORY SPARE LIST FOR COMPRESSED AIR SYSTEM PACKAGE (annexure-IX)		
Sl. No.	Description	Quantity for each type of equipment / instrument
1	SCREW COMPRESSOR	
1.1	HP Stages of Compressor	
	(i) HP element	One (1) Set
	(ii) Packing Set	Four (4) Sets
	(iii) Axial thrust brg.	Two (2) Sets
	(iv) Labyrinth oil seal or radial seals or double acting seals for drive shaft	Four (4) Sets
	v) Bearing for male & female rotors (DE & NDE)	Two (2) each
	vi) Timing Gears	One (1)
	vii) Suction & discharge valves	Two (2) each
1.2	LP Stages of Compressor	
	(i) LP element	One (1) Set
	(ii) Graphitic ring shaft seals for compressor chamber or white	Four (4) Sets
	(iii) Packing Set	Four (4) Sets
	(iv) Axial thrust Bearing	Two (2) Sets
	v) Bearing for male & female rotors (DE & NDE)	Two (2) each
	vi) Timing Gears	One (1)
	vii) Suction & discharge valves	Two (2) each
1.3	Main Bearing	Two (2) each
1.4	Step up gear/pinion (HP and LP Stage)	One (1) each
1.5	Air intake filter element with gaskets	Eight (8)
1.6	Oil filter element with gaskets & seals	Eight (8)
1.7	Safety valve springs & gaskets (HP and LP Stage)	Four (4) each
1.8	One set of inbuilt automatic drain valve	Four (4)
1.9	Gearcase breather filterelemnt	One (1)
1.1	Drain valve kit	One (1)
1.11	Compressors Coolers	
	l) Gaskets & seals for inter cooler and after cooler	Four (4)
	ii) Inter cooler drain check valve	One (1)

Note:

1 set = 1 compressor requirement

1.12	Oil Pump/Motor	
	i) Oil pump complete assembly	One (1)
	ii) Pump impeller/rotor with shaft	One (1)
	iii) Set of bearings	Two (2) Sets
	iv) Oil pump motor bearing	Two (2)
1.13	Shaft driven oil pump	
	i) Drive gear with shaft	One (1)
	ii) Driven gear with shaft	One (1)
1.14	Drain tap elements	Four (4)
1.15	Moisture tap elements	Four (4)
1.16	Oil cooler gaskets and seals	Four (4)
1.17	Seal Washer	Two (2)
1.18	Mass flow Meter	One (1)
1.19	Air Drying Plant	
	i) Pre filter element (ceramic candle)	Two (2)
	ii) After filter element (ceramic candle)	Two (2)
	iii) Heater element (if required)	Two (2)
	iv) Blower bearing (if required)	Two (2)
	v) Blower motor bearing (if required)	Two (2)
	vi) Valve actuators	Two (2)
	vii) Inlet & Outlet valve for Dryer	One (1) Set
	viii) Automatic drain valves (No air loss type)	One (1) Set
	ix) Expansion valves	One (1) Set
	x) Filter Dryer	One (1) Set
	xi) Air cooler condenser fan	One (1) Set
	xii) Filter Drier for refrigerant	One (1) Set
	xiii)Refrigerant High Pressure Switch	One (1) Set
	xiv)Refrigerant Low Pressure Switch	One (1) Set
	xv) Water line pressure switch	One (1) Set
	xvi) Thermostatic expansion valve	One (1) Set
	xvii) Micro Filter Cartridge	One (1) Set
	xviii) Solenoid valve	One (1) Set
	xix) Single phase preventer	One (1) Set
	xx) Auto Drain Valve with Coil	One (1) Set
	xxi) Water Line strainer filter	One (1) Set
1.20	Micro Controller- fully programmed	One (1) Set

Note:

1 set = 1 compressor requirement

2	ELECTRICAL ITEMS		
2.1	HT Motor (other than BFP Motor)		
2.1.1	Complete Set of Coupling		1 Set for each Application
3	C & I ITEMS		
3.1	Field Instruments		
3.1.1	Transmitters/ Gauges/Switches etc. along with relevant accessories		10% of total or at least two (whichever is higher) for each type along with accessories.
3.1.2	Temperature Element (RTD/Thermo-couple) with thermowell		10% of each type , range and immersion length . Minimum 5 nos.



**TECHNICAL SPECIFICATION FOR
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1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
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ANNEXURE – X

PRE BID CLARIFICATION FORMAT

TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM

VOLUME III

SECTION D

REV 00

DATE _____

SHEET OF

[illegible]

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

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**TECHNICAL SPECIFICATION FOR
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1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
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ANNEXURE – XI

SCHEDULE OF DEVIATIONS

(All deviations from the Technical Specification shall be filled in by the BIDDER clause by clause in this schedule)

ANNEXURE XI

PROJECT:- 1 X 800 MW KOTHAGUDEM TPS, STAGE-VII, UNIT-12

PACKAGE:- COMPRESSED AIR SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME		DESIGNATIONS			SIGN & DATE				
NOTES:									
1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									

9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



**TECHNICAL SPECIFICATION FOR
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1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
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ANNEXURE – XII

PRICE FORMAT

1 X 800 MW KOTHAGUDAM TPS										Rev 00	10.04.2015
PRICE SCHEDULE - COMPRESSED AIR SYSTEM PACKAGE											
Sl.No	DESCRIPTION OF EQUIPMENT /	ITEM	Ex-works price	ED	CST / VAT	FREIGHT	E&C Charges	Service tax on E & C	Total		
1	2	3	4	5	6	7	8	9 (3 to 8)			
1.0.0	Total lumpsum firm prices for the supply of equipment & services as specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, loading, unloading & storage at site, supply of erection materials, consumables, start-up & commissioning spares, and mandatory spares as required to complete the compressed air system including service part for unloading, storage & handling at site, erection, commissioning, trial run, carrying out performance tests at site, handing over to customer in line with drawings/ documents/ test procedures approved by BHEL/ customer, for the total scope defined in technical specification (spec.No. PE-TS-410-555-A001) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Compressed Air System for 1 X 800 MW KOTHAGUDEM TPS.										
NOTES	Bidder to note that total price indicated above at 1.0.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.										
a	Any item not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.										
b	Total Lumpsum price in column-9 should match with summation of total prices as in [Column (12) of 1.0.0 of Annexure- I + Column (9) of A of Annexure - II + Column (5) of 1.0.0 of Annexure- III .										
c	As per cl. no. 3.0 of GCC Rev-06, Total erection & commissioning charges including service tax should be minimum 20% (or as specified in NIT) of the total quoted package price (excluding mandatory spares but including all taxes and freight), failing which the break-up of prices shall be adjusted accordingly for ordering.										
d	All deviations should be marked in Cost of withdrawal sheet (Annexure-VI) only. Deviations marked elsewhere other than schedule of deviation shall not be taken into cognizance.										
e	Bidder to fill import content in Annexure-IV. However,, any benefits w.r.t taxes and duties will be governed by the commercial terms and conditions in this tender.										
f	Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.										
	Bidder's / bidder's representative signature							Company seal			

PRICE SCHEDULE											
1 X 800 MW KOTHAGUDAM TPP											
Rev 00 10.04.20											
ANNEXURE-I											
MAIN SUPPLY - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE											
Sl.No	DESCRIPTION OF EQUIPMENT / ITEM	QUANTITY	UNIT PRICE			TOTAL PRICE			REMARKS		
			Ex-works price	ED	CST / VAT	FREIGHT	Ex-works price	ED	CST / VAT	FREIGHT	FOR SITE
1	2	3	4	5	6	7	8	9	10	11	12 (8 to 11)
1.0.0	Total lumpsum firm prices for the supply of equipment & services as specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed for Transportation, Delivery to Site, loading, unloading & storage at site, supply of erection materials, consumables, start-up & commissioning spares, and mandatory spares as required to complete the compressed air system for the total scope defined in technical specification (spec.No. PE-TS-410-555-A001) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Compressed Air System for 1 X 800 MW KOTHAGUDEM TPS.										
2.0.0	Break Up Prices										
2.1.0	Instrument Compressor (oil free Screw) Each of 30 NM3/Minute capacity at 8.5 kg/cm2 (g) with accessories, Suction filter and silencer, Inner Cooler, After Cooler with moisture separators, automatic drain traps, instruments, Control panel etc. (Electric motor to drive the compressor is excluded from bidders scope).	3									
2.2.0	Service Air Compressor (oil free Screw) Each of 30 NM3/Minute capacity at 8.5 kg/cm2 (g) with accessories, Suction filter and silencer, Inner Cooler, After Cooler with moisture separators, automatic drain traps, instruments, Control panel etc. (Electric motor to drive the compressor is excluded from bidders scope)	3									
2.3.0	Air Dryer (Refrigerant Type) Air Drying Plant of 33 NM ³ /min and to match instrument air compressor with all instruments and controls including Electronic Dew point meter as specified.	3									
2.4.0	Air receivers Air receiver at Compressor house of 15 M ³ capacity with each having Pressure gauges, Temperature gauges, Relief valve, Drain connection with zero purge type automatic trap stations and other accessories as specified.	7									
2.5.0	Pipes & fittings Inter connecting cooling water, compressed air piping & Drain piping up to the nearest common drain point outside compressor house as specified including fittings and valves, etc. for complete compressed air system	1									
2.6.0	Field instruments as specified including temperature scanners as specified.	1									
2.7.0	Cable, Cable lugs, glands, junction box etc for Compressed Air System equipment as required.	1									
2.8.0	Total lump sum prices for Start-Up & commissioning spares (as specified in the Annexure-VIII, Volume-III of the technical specification PE-TS-410-555-A001)	1									
3.0.0	Total of 2.6.0 (Total of 2.1.0 to 2.8.0) (should match with column(12) of 1.0.0)										
	Bidder's / bidder's representative signature									Company seal	

PRICE SCHEDULE					Rev 00	10.04.2015		
1 X 800 MW KOTHAGUDAM TPP								
ANNEXURE II								
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE								
Sl.no	Description	Qty.	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2	3	4	5	6	7	8	9
1	SCREW COMPRESSOR							
1.1	HP Stages of Compressor							
	(i) HP element	One (1) Set						
	(ii) Packing Set	Four (4) Sets						
	(iii) Axial thrust brg.	Two (2) Sets						
	(iv) Labyrinth oil seal or radial seals or	Four (4) Sets						
	v) Bearing for male & female rot	Two (2) each						
	vi) Timing Gears	One (1)						
	vii) Suction & discharge valves	Two (2) each						
1.2	LP Stages of Compressor							
	(i) LP element	One (1) Set						
	(ii) Graphitic ring shaft seals for	Four (4) Sets						
	(iii) Packing Set	Four (4) Sets						
	(iv) Axial thrust Bearing	Two (2) Sets						
	v) Bearing for male & female rot	Two (2) each						
	vi) Timing Gears	One (1)						
	vii) Suction & discharge valves	Two (2) each						
1.3	Main Bearing	Two (2) each						
1.4	Step up gear/pinion (HP and LP	One (1) each						
1.5	Air intake filter element with gaskets	Eight (8)						
1.6	Oil filter element with gaskets & seals	Eight (8)						
1.7	Safety valve springs & gaskets (HP and LP Stage)	Four (4) each						
1.8	One set of inbuilt automatic drain valve	Four (4)						
1.9	Gearcase breather filter elemnt	One (1)						
1.1	Drain valve kit	One (1)						
1.11	Compressors Coolers							
	i) Gaskets & seals for inter cooler and after cooler	Four (4)						
	ii) Inter cooler drain check valve	One (1)						
1.12	Oil Pump/Motor							
	i) Oil pump complete assembly	One (1)						
	ii) Pump impeller/rotor with shaft	One (1)						
	iii) Set of bearings	Two (2) Sets						
	iv) Oil pump motor bearing	Two (2)						
1.13	Shaft driven oil pump							
	i) Drive gear with shaft	One (1)						
	ii) Driven gear with shaft	One (1)						
1.14	Drain tap elements	Four (4)						
1.15	Moisture tap elements	Four (4)						
1.16	Oil cooler gaskets and seals	Four (4)						
1.17	Seal Washer	Two (2)						

PRICE SCHEDULE					Rev 00	10.04.2015		
1 X 800 MW KOTHAGUDAM TPP								
ANNEXURE II								
PRICE SCHEDULE FOR MANDATORY SPARES OF COMPRESSED AIR SYSTEM PACKAGE								
Sl.no	Description	Qty.	Unit Ex-works price	Total ex-works price	ED	CST	FREIGHT	FOR SITE
1	2	3	4	5	6	7	8	9
1.18	Mass flow Meter	One (1)						
1.19	Air Drying Plant							
	i) Pre filter element (ceramic candle)	Two (2)						
	ii) After filter element (ceramic candle)	Two (2)						
	iii) Heater element (if required)	Two (2)						
	iv) Blower bearing (if required)	Two (2)						
	v) Blower motor bearing (if required)	Two (2)						
	vi) Valve actuators	Two (2)						
	vii) Inlet & Outlet valve for Dryer	One (1) Set						
	viii) Automatic drain valves (No air loss type)	One (1) Set						
	ix) Espansion valves	One (1) Set						
	x) Filter Dryer	One (1) Set						
	xi) Air cooler condenser fan	One (1) Set						
	xii) Filter Drier for refrigerant	One (1) Set						
	xiii)Refrigerant High Pressure Switch	One (1) Set						
	xiv)Refrigerant Low Pressure Switch	One (1) Set						
	xv) Water line pressure switch	One (1) Set						
	xvi) Thermostatic expansion valve	One (1) Set						
	xvii) Micro Filter Cartridge	One (1) Set						
	xviii) Solenoid valve	One (1) Set						
	xix) Single phase preventer	One (1) Set						
	xx) Auto Drain Valve with Coil	One (1) Set						
	xxi) Water Line strainer filter	One (1) Set						
1.20	Micro Controller- fully programmed	One (1) Set						
2	ELECTRICAL ITEMS							
2.1	HT Motor (other than BFP Motor)							
2.1.1	Complete Set of Coupling	1 Set						
3	C & I ITEMS							
3.1	Field Instruments							
3.1.1	Transmitters/ Gauges/Switches etc. along with relevant accessories	10% of total or at least two (whichever is higher) for each type along with accessories.						
3.1.2	Temperature Element (RTD/Thermo-couple) with thermowell	10% of each type , range and immersion length . Minimum 5 nos.						
A	Total Lumpsum price of Mandatory Spares							
Notes								
a)	Unless stated otherwise, a 'set' means item or sub-items required for each type/ size, range of assembly/ sub- assembly required for complete replacement in one equipment system; it is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in marinating two different sets of spares to be used for subject assembly/ sub assembly, these shall be considered as different type of assembly/ sub assembly.							
b)	Wherever quantity has been specified as percentage(%), the quantity of mandatory spares to be provided by the vendor shall be the specified percentage (%) of total population required to meet the specification requirements. In case the quantity of mandatory spares so calculated happens to be in fraction, the same shall be rounded off to next higher whole number.							
c)	Wherever the quantities have been indicated for each type, size, thickness, material, radius , range etc, these shall cover all the items supplied and installed and the breakup of these shall be furnished by the vendor during detail engineering.							
d)	In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to the offered design with quantities genaerally in line with the approach followed in the above list.							
e)	Wherever bidder has indicated an item as not applicable, the same will have to be supplied free of cost, incase it is found applicable during detail engineering.							
Bidder's / bidder's representative signature						Company seal		

PRICE SCHEDULE				Rev 00	10.04.2015
1 X 800 MW KOTHAGUDAM TPP					
ANNEXURE-III					
ERECTION & COMMISSIONING - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE					
Sl.No	DESCRIPTION OF EQUIPMENT /	ITEM	E&C Charges	Service tax on E & C	Total
1	2		3	4	5 (3 to 4)
1.0.0	Total lumpsum firm prices for the services as specified, comprising of service part for unloading, storage & handling at site, erection, commissioning, trial run, carrying out performance tests at site, handing over to customer in line with drawings/ documents/ test procedures approved by BHEL/ customer, for the total scope defined in technical specification (spec.No. PE-TS-410-555-A001) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Compressed Air System for 1 X 800 MW KOTHAGUDEM TPS.				
NOTE:					
1	As per cl. no. 3.0 of GCC Rev-06, Total erection & commissioning charges including service tax should be minimum 20% (or as specified in NIT) of the total quoted package price (excluding mandatory spares but including all taxes and freight), failing which the break-up of prices shall be adjusted accordingly for ordering.				
	Bidder's / bidder's representative signature		Company seal		

PRICE SCHEDULE			Rev 00	10.04.2015
1 X 800 MW KOTHAGUDAM TPP				
ANNEXURE-IV				
IMPORT CONTENT - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE				
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM		ALL INCLUSIVE PRICE (As per tender)	
1.0	Total price (in terms of `Euro/US \$' and correspondingly in INR as on date) for supply of import content, as required, for total scope defined as per technical specification and terms & conditions of tender taking into account all clarifications, confirmations and agreements till date. (Bidder shall furnish item-wise break-up in a separate sheet)			
1.1.1	In Euro.			
1.1.2	In INR (Corresponding to 1.1.1).			
1.2.1	In US \$.			
1.2.2	In INR (Corresponding to 1.2.1).			
1.3	Total in INR (1.1.2 + 1.2.2).			
NOTE				
1.0	Bidder's quoted price in various schedules shall be inclusive of above total price for import component at sl no 1.3 above.			
2.0	Bidder shall furnish item-wise break-up of imported items.			

PRICE SCHEDULE				Rev 00	10.04.2015	
1 X 800 MW KOTHAGUDAM TPP						
ANNEXURE-V						
GUARANTEED POWER CONSUMPTION - PRICE SCHEDULE FOR COMPRESSED AIR SYSTEM PACKAGE						
Guaranteed Power Consumption For Air Compressor System Shall be as per Following :						
S.No. (1)	Description of Equipments (2)	Nos. of Equipments (3)		Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)	Duty Factor (5)	Total (KW) (6) = (3A)*(4)*(5)
		Working (3A)	Standby (3B)			
1	Serve Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2 pressure	2	1		0.5	
2	Instrument Air Compressor (Oil free Screw type) 30 NM3/min at 8.5 Kg/cm2	2	1		0.5	
3	Air Drying Plant Unit (Refrigerant type)	2	1		0.5	
					TOTAL	
Note :						
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is 540 KW (For station)					
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) including power for control panel as furnished in guranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.					
3	The price quoted by the bidder shall be loaded @ (INR)200000/- for every additional kW increase in consumption from the base figure indicated at Note no. 1.0 above.					
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption) on actual performance testing at the manufacturing works / site, penalty @ (INR)200000/- per kW increase in power consumption figure shall be levied.					

DEVIATION SHEET (COST OF WITHDRAWAL)									
ANNEXURE-VI									
PROJECT:- 1 X 800 MW KOTHAGUDAM TPP									
PACKAGE:- COMPRESSED AIR SYSTEM PACKAGE									
TENDER ENQUIRY REFERENCE:-									
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATIO N/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS			SIGN & DATE		
NOTES:									
1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.									
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.									
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001

VOLUME

SECTION

REVISION 00

DATE: 03/04/2015

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ANNEXURE – XIII

SITE STORAGE AND PRESERVATION GUIDELINES

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

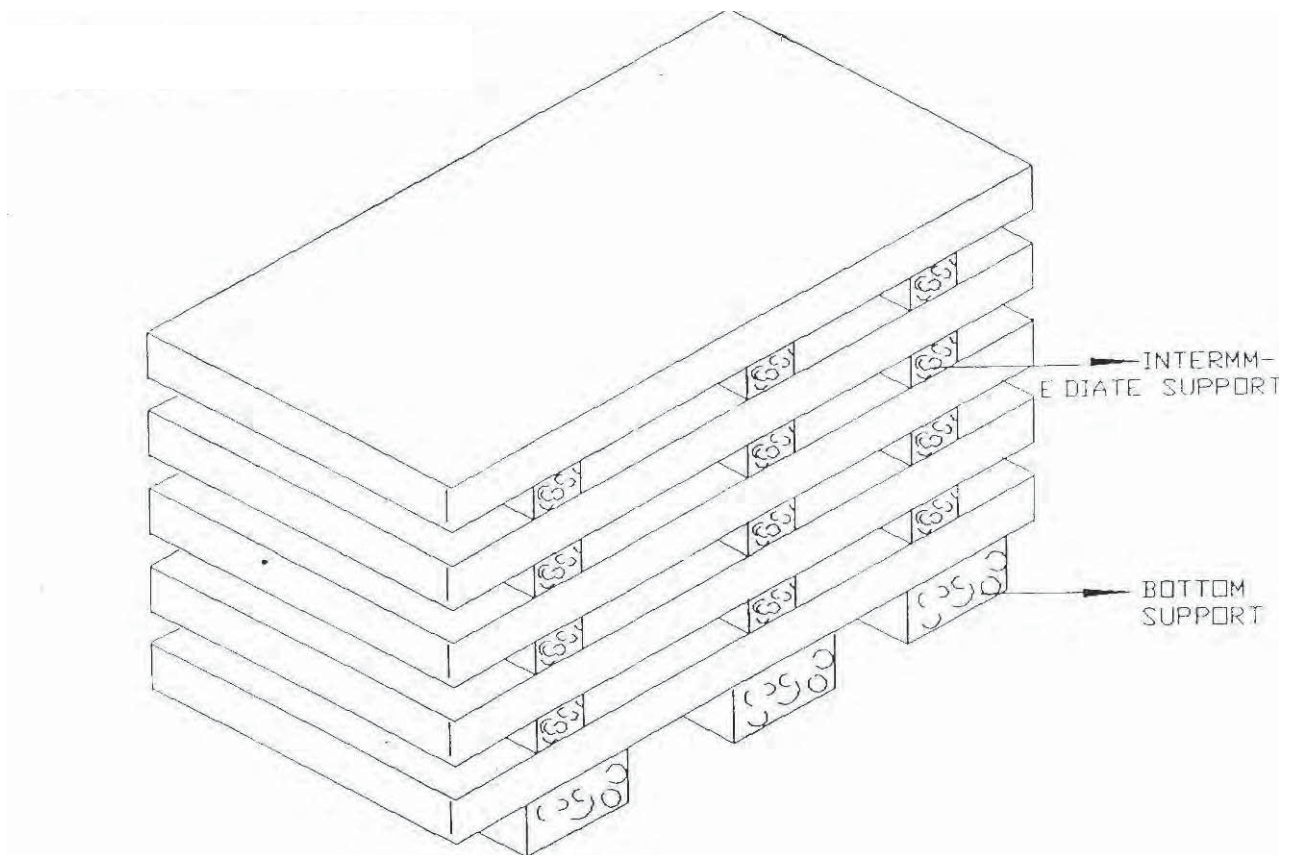


Figure – 1 – PLATE STACKING ARRANGEMENT

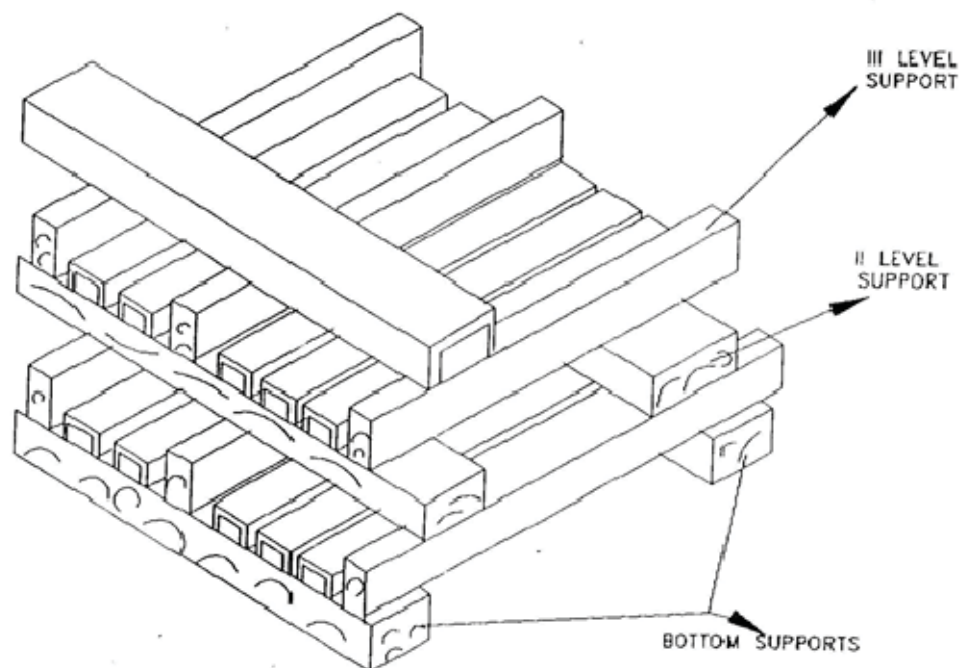


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
1 X 800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT-12**

SPECIFICATION NO. PE-TS-410-555-A001	
VOLUME	SECTION
REVISION 00	DATE: 03/04/2015
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**ANNEXURE - XIV
CHECK LIST**



TITLE:

**TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM TPS, STAGE-VII,
UNIT No. 12
COMPRESSED AIR SYSTEM**

SPEC. NO.: PE-TS-410-555-A001

VOLUME: III

SECTION:

REV. NO. 0 DATE

SHEET 1 OF 1

CHECK LIST TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

Sl No.	Item Description	Yes/No
1	Schedules to be submitted dully filled up with bidder's signature and stamp. 1) Technical Deviation Schedule (Volume III-Annexure-XI) 2) List of Mandatory Spares (Volume III-Annexure-IX) 3) List of Maintenance Tool & Tackles (Volume III-Annexure-VII) 4) List of commissioning spares (Volume III-Annexure-VIII) 5) Guaranteed Power Consumption For Air Compressor System (Volume III-Annexure-III) 6) Compliance and Confirmation certificate (Volume III-Annexure-I)	
2	Resolution to pre-bid clarifications, if any, duly stamped and signed by the bidder enclosed with the bid	
3		
4	Un-priced bid- clearly indicating 'QUOTED' and 'NOT-QUOTED' against each item.	
5	'Compressor House Layout (Document no.PE-DG-410-555-SK002)-(Volume III-Annexure-VI) of technical specification' duly stamped and signed by bidder to be enclosed with the bid.	
6	Electrical load List (Volume III-Annexure-IV) of technical specification duly filled, stamped and signed by bidder to be enclosed with the bid	
7	Supporting Documents meeting PQR requirements(if Applicable)	
8	Offered model of compressor matching FAD calculation along with the catalogue of the offered model to justify selection.	

Please note that all the schedules shall be submitted even though they may not be applicable. Under such circumstances it shall be clearly mentioned across such schedules that these are not applicable.(e.g. in case of there are no technical deviation, it shall be mentioned in the deviation schedule that ' THERE ARE NO DEVIATIONES TO THE TECHNICAL SPECIFICATION').

Name: _____

Signature: _____

Designation: _____

Company: _____

Date: _____

Bidder Stamp