

PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)

TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM PACKAGE

SPECIFICATION NO.: PE- TS- 434- 555- A001, Rev 00



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



TITLE

3 X 800 MW PATRATU STPS

INDEX

SPECIFICATION NO. PE-TS-434-555-A001

REV 00

SHEET 1 OF 1

SECTIONS	TITLE	PAGE NO.
SECTION-I	SPECIFIC TECHNICAL REQUIREMENT	
	INTENT OF SPECIFICATION	3-5
SECTION-IA	SPECIFIC TECHNICAL REQUIREMENT - MECHANICAL	6
	SCOPE OF SUPPLY, EXCLUSIONS, TERMINAL POINTS AND OTHER PROJECT SPECIFIC REQUIREMENTS)	7-12
	FUNCTIONAL / DEMOSTARTION GUARANTEE (AS APPLICABLE)	13-14
	GENERAL TECHNICAL SPECIFICATION	15-129
	QUALITY ASSURANCE AND INSPECTION REQUIREMENT	130-132
	ANNEXURE-I (SUB-VENDOR LIST)	133-171
	ANNEXURE-II (MDL WITH SUBMISSION SCHEDULE)	172-173
	ANNEXURE-III (INPUT DRAWINGS)	174-179
	ANNEXURE-IV (MANDATORY SPARES)	180-184
	ANNEXURE-V (DM WATER ANALYSIS)	185-186
	ANNEXURE-VI (CUSTOMER SPECIFICATION)	187-195
	ANNEXURE-VII (PAINTING)	196-205
SECTION-IB	SPECIFIC TECHNICAL REQUIREMENT - ELECTRICAL	206-212
SECTION-IC	SPECIFIC TECHNICAL REQUIREMENT - C & I	213-323
SECTION-II	STANDARD TECHNICAL SPECIFICATIONS	324
SECTION-IIA	FORMAT FOR OPERATION AND MANITENANCE	325-328
SECTION-IIB	SITE STORAGE AND PRESERVATION	329-344
SECTION-III	DOCUMENTS TO BE SUBMITTED BY THE BIDDER	345
SECTION - IIIA	LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	346
SECTION - IIIB	COMPLIANCE CUM CONFIRMATION CERTIFICATE	347-348
SECTION - IIIC	PRE BID CLARIFICATION SCHEDULE	349
SECTION - IIID	SCHEDULE OF TECHNICAL DEVIATION	350
SECTION - IIIE	ELECTRIC LOAD DATA	351-352
SECTION - IIIF	GUARANTEED POWER CONSUMPTION	353

3 X 800MW PATRATU STPS

SECTION – I (INTENT OF SPECIFICATION)



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



TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
3X800MW PATRATU STPS

SPECIFICATION NO. PE-TS-434-555-A001

SECTION I

REV – 00

DATE -

INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles , fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, shipment and delivery (at site , as per NIT conditions) , unloading, handling, transportation & storage at site in containers , in-site transportation, assembly, erection & commissioning, trial run at site, and carrying out performance guarantee/Functional/Demonstration tests at site ,(training of customer/client O&M staff and final handing over to end customer in flawless condition of compressors for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning of 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 **within 10 days of receipt of tender documents**. 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 by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
3X800MW PATRATU STPS**

SPECIFICATION NO. PE-TS-434-555-A001

SECTION I

REV – 00

DATE -

- 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 deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the bidder's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.
- 1.12 Apart from specific design requirement for compressor, design of various systems/ Sub-systems and all equipment will also strictly meet the stipulations of Customer's Technical Specification.

3X800MW PATRATU STPS

SECTION I-A

SPECIFIC TECHNICAL REQUIREMENT -MECHANICAL



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

	TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800MW PATRATU STPS		SPECIFICATION NO. PE-TS-434-555-A001
			SECTION I
	REVISION 00		DATE:
	PAGE 2 of 7		

1. SCOPE OF SUPPLY AND SERVICES:

1.1 The scope of supply under this specification shall be as below.

Total scope comprise engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles , fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, shipment and delivery (at site , as per NIT conditions) , unloading, handling, transportation & storage at site in containers , in-site transportation, assembly, erection & commissioning, trial run at site, and carrying out performance guarantee/Functional/Demonstration tests at site ,(training of customer/client O&M staff and final handing over to end customer in flawless condition of compressors for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

Complete Compressed Air System consisting of following equipment:

- 1.1.1 Three (3) nos. Instrument Air Compressors (Oil Free Screw type/Centrifugal type) each of minimum 65 NM³/Min capacity at 8.0 Kg/sqcm (min) discharge pressure with suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories. Electric motor for compressors are excluded from bidder's scope.
- 1.1.2 Three (3) nos. Air Drying Plants Heat of compression (HOC) Rotary drum type / Dual Tower Type of min. 65NM³/min. capacity at 7.5 Kg/sqcm (min) discharge pressure (At outlet of Air Dryer Plant) connected to above IA compressors with all instruments like dew point meters, control panels and other accessories as specified.
- 1.1.3 Two (2) nos. Service Air Compressors (Oil Free Screw type / Centrifugal type) each of minimum 65 NM³/Min capacity at 8.0 Kg/sqcm (min) discharge pressure with suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system and other accessories. Electric motor for compressors are excluded from bidder's scope.
- 1.1.4 Eight (8) nos. Air Receivers (Five (5) nos adjacent to compressor house and Three (3) nos in TG Hall B-C Bay) of minimum Ten (10.) Cu.M capacity each with instruments, relief valve, drain connection with automatic trap stations and other accessories as specified.
- 1.1.5 One (1) no Air Receiver of minimum Two (2) Cu.M capacity near DM plant with instruments, relief valve, drain connection with automatic trap stations and other accessories as specified.
- 1.1.6 Three (3) nos. Electronic Dew point meters.
- 1.1.7 All interconnecting compressed air piping and cooling water piping alongwith fittings. -1 Lot .
- 1.1.8 All compressed air line valves and cooling water line valves. – 1 Lot
- 1.1.9 Field instruments as specified, all instruments necessary for performance testing of compressors as well as air drying plants.
- 1.1.10 Any type of special cable as per electrical scope sheet given under electrical portion of specification.
- 1.1.11 Mendatory spares :- 1 Lot as specified
- 1.1.12 Maintenance tools and tackles, start up and commissioning spares, consumables, first fill of lubricants inclusive of packing – Lot

	TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800MW PATRATU STPS	SPECIFICATION NO. PE-TS-434-555-A001	
		SECTION I	SECTION I
		REVISION 00	DATE:
		PAGE 3 of 7	

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.

1.1.14 Civil works: - Grouting of equipment's, like Air receiver, Air dryer & foundation bolts etc. are in the scope of the bidder. Minor dressings of foundation blocks, supply and fixing of supports etc. on walls, foundations, floor and trenches will be done by successful bidder.

1.1.15 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.

1.2 The scope of services under this specification shall be as below.

Delivery to site (as per NIT condition), unloading storage & handling at site, erection & commissioning, carrying out performance/acceptance tests at site & final painting of complete Compressed Air System consisting of following equipment:

- 1.2.1 Unloading, transportation and storage at site
- 1.2.2 Erection and commissioning
- 1.2.3 Conducting PG Test/Demonstration Test as per details mentioned elsewhere in the specification.
- 1.2.4 Minor civil work (as per scope mentioned at s.no. 1.1.14)
- 1.2.5 Items mentioned under Electrical and C&I portion of Specification.
- 1.2.6 Any service mentioned in GCC & SCC and other part of specification as required for Compressed Air System

2 DESIGN REQUIREMENT

- 2.1 Design Inlet conditions for Compressor: Site conditions are given in part B0 of customer tech specification,
- a) Temp: 45
 - b) Relative humidity: 75
 - c) Altitude: 335 M above MSL

2.2 The maximum velocity to be considered in compressed air shall be 15.0 m/s.

2.3 Compressor and air dryer shall be designed for cooling water (passivated DM water) with inlet temp of 38 degC (max.) with terminal pressure 06 kg/sqcm (g) and rise in temp shall be limited to 7 degC 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. Qty of cooling water shall be 600 cum/hr considering working equipment's only.

3.0 TERMINAL POINTS:

- 3.1 Bidder will terminate compressed air piping at common IA header and common SA header downstream of air receiver (at 5.0 m from compressor house building) as per enclosed tender drawing.
- 3.2 Cooling water supply pipeline connection will be provided by the purchaser outside the compressor house (at 5.0 m from compressor house building). The return hot water shall be terminated by the contractor at the same location. Further interconnection from these terminal points shall be in bidder's scope.

	TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800MW PATRATU STPS		SPECIFICATION NO. PE-TS-434-555-A001
			SECTION I SECTION I
	REVISION 00		DATE:
	PAGE 4 of 7		

4.0 SUB-VENDOR ITEMS

The tentative make of Sub-vendor items shall be as per **Annexure-I** enclosed. Bidder to note that Bidder to note that category of inspections and makes for listed items are subject to customer approval during detail engineering and may change. No cost and delivery implication is admissible on account of such changes.

5.0 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 **SECTION-III A**. Any documents other than those indicated in Section IIIA will not be reviewed and will not form part of contract.

6.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

Tentative list of drawing / document required during detail engineering is attached in **ANNEXURE-II**. Any other drawings and documents as required by BHEL / Customer shall be furnished by the successful bidder during detail engineering stage for which no commercial implication shall be entertained by BHEL.

7.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION

Drawings enclosed under **ANNEXURE-III**, will form part of the specification. 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 comments, if any, during approval has to be incorporated by successful bidder 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.

8.0 OTHER REQUIREMENTS

8.1 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.

8.2 Quality Plans attached in different sections of this specification are indicating minimum requirements for inspection and testing. Bidder shall note that quality plan is subject to Customer & BHEL approval during detail engineering stage. All the comments by BHEL/customer shall be complied by successful bidder without any commercial & delivery implication to BHEL. Sample quality plan is attached for bidder's reference. However, Inspection and testing of CAS Components shall be as per quality plans approved by BHEL and / or Customer.

8.3 The O&M Manual to be submitted by the successful bidder will necessarily address the following (refer **SECTION-IIA** also):

- 8.3.1 Complete System Description along with PIDs, write up on electrical philosophy and safety/process interlocks etc.
- 8.3.2 Instructions for plant operation
- 8.3.3 Commissioning procedure of the system

	TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800MW PATRATU STPS	SPECIFICATION NO. PE-TS-434-555-A001	
		SECTION I	SECTION I
		REVISION 00	DATE:
		PAGE 5 of 7	

8.3.4 Chapter on precautions to be taken during:

➤ Operation

➤ Idle time

➤ Long shutdown

8.3.5 Chapter on trouble shooting during plant operation covering:

➤ Safely aspects

➤ Do's and do not's

➤ Maintenance schedule

➤ Schedule of lubricants & consumables

8.3.6 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.

8.4 Drawings/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 requirements 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.

8.5 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.

8.5.1 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 approval and adequate training for

10

28/06/2018

	TECHNICAL SPECIFICATION FOR		SPECIFICATION NO. PE-TS-434-555-A001	
	COMPRESSED AIR SYSTEM		SECTION I	SECTION I
	3X800MW PATRATU STPS		REVISION 00	DATE:
			PAGE 6 of 7	

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

8.5.2 Internet speed – 2 mbps (Minimum preferred)

8.5.3 Pop ups from our external DMS IP (124.124.36.198) should not be blocked

8.5.4 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>

8.6 Electrical Load List have been attached in technical specification for bidder's compliance as Annexure-IIIIE. In case Final Electrical Load list submitted by the successful bidder as per agreed drawing/ doc submission schedule results in alteration of loads, such changes in electrical load list shall be entertained only subject to its feasibility and BHEL reserves the right to debit the vendor cost for any modification as necessitated in the switch gear /MCC on account of changed loads.

8.7 Guaranteed power consumption have been attached in technical specification for bidder's compliance as Annexure-IIIF. Guaranteed Power Consumption Format shall be submitted in open along with techno commercial offer only.

8.8 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".

8.9 If any deviation is there, then same to be indicated separately under the heading "Schedule of Technical Deviation" enclosed under Section III 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.

9 ADDITIONAL POINTS TO BE NOTED BY BIDDER

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

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

9.3 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). Cable schedule and inter connection diagram required for transmitting the signals of RTD/BTD through microprocessor to DDCMIS has to be furnished by

	TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800MW PATRATU STPS		SPECIFICATION NO. PE-TS-434-555-A001
			SECTION I SECTION I
	REVISION 00		DATE:
	PAGE 7 of 7		

successful bidder during detailed engineering. Tentative GA drawing of motor is attached for bidder's estimation.

- 9.4 Control and Instrumentation – Individual compressor control shall be through compressor mounted microprocessor based control panel. Each compressor shall be interfaced with DCS through gateway / convertor for start, stop, load and unload from common control room (CCR) including giving input for developing software at DCS (by BHEL EDN) and hardware link for status monitoring, start/stop, load/unload from CCR.

Group Control is envisaged to clock more or less equal number of running hours for each Instrument Air Compressor. Due to this feature in case of increase in air demand, the Unit which had clocked least no. of running hours shall be started and loaded. Similarly, when the air demand goes down, the Unit which had clocked most no. of running hours shall be unloaded and stopped

- 9.5 All the instruments as required for performance testing shall be arranged by bidder. Instrument for testing shall be calibrated from government certified labs by bidder. Bidder to ensure validity of such reports before conducting the performance tests.
- 9.6 Height of Air receivers shall be limited to 4M for all air receivers.
- 9.7 The layout of compressor house building has been attached under **ANNEXURE-III**. Dimension of compressor house building is length 30m, width 17 m and clear height 9.8 m; Bidder is required to accommodate all the equipments inside this allocated space only. The said layout shall be considered for accommodating its equipments by successful bidder while preparing the compressor house layout during detailed engineering stage.
- 9.8 Civil works including construction of compressor house, foundation of all compressor, air dryer and Air receiver, pipe / cable trenches.

10.0 EXCLUSIONS:

- 10.1 MCC/Switchgear for power supply to Air Compressors, other drives and panels.
- 10.2 Lighting and ventilation of compressor house.
- 10.3 HT motor for all compressors and its VMS.
- 10.4 Monorail hoists/Cranes as necessary for handling of equipment after erection.

3 X 800MW PATRAU STPS

SECTION IA

(FUNCTIONAL / PERFORMANCE / DEMONSTRATION REQUIREMENT)



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

	TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800MW PATRATU STPS	SPECIFICATION NO. PE-TS-434-555-A001	
			SECTION IA
		REVISION 00	DATE:
		PAGE 2 of 2	

1.0 For Category-I Guarantees.

Reject the equipment/system/plant and recover the payments already made.

OR

Accept the equipment/system/plant after levying Liquidated damages as specified.

(A) Plant & Instrument air compressors & Air drying plant

Power consumption of:-

- i) Instrument Air compressor 2 Nos. Duty Factor =0.6
- ii) Plant Air compressor 2 Nos. Duty Factor = 0.33
- iii) Air Drying plant (Heaters) (if applicable) 2 Nos. Duty Factor =0.5
- iv) Air Drying plant (Blowers) (if applicable) 2 Nos. Duty Factor = 1.0

Power consumption at rated duty point for compressors to be arrived based on shop test and power consumption at rated duty point for Air Drying plant to be arrived based on site test

2.0 For Category-III Guarantees.

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

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the employer. Such damages shall, however be limited to the cost of replacement of the deficiency so as to achieve the guarantee performance.

AIR COMPRESSOR UNIT

a) Following shall be demonstrated at shop:

- i) Capacity and discharge pressure of each air compressor.

b) Following shall be demonstrated at site:

- i) Parallel operation of air compressors
- ii) Dew point of air at the outlet of air drying plants of instrument air compressor.
- iv) Pressure drop across the air drying plants of air compressors.
- v) Vibration and noise level of air compressors, blowers of air drying plant

3 X 800MW PATRATU STPS

SECTION IA (GENERAL TECHNICAL SPECIFICATION)



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

GENERAL TECHNICAL REQUIREMENTS

PART - C

CONTENTS

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

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

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3x800 MW)	TECHNICAL SPECIFICATION SECTION-VI, PART-C BID DOC NO: CS-9585-001-2
---	---

Clause No.	Description	Page No.
	Annexure - I	78
	Annexure - II	79
	Annexure - III	80
	Annexure - IV	81
	Annexure - V	82
	Annexure - VI	83
	Annexure - VII	85
	Annexure - VIII	92
	Annexure - IX	103
	Annexure – X	106
	Annexure – XI	107
	Annexure – XII	109

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.		
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.		
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.		
4.00.00	COMPLETENESS OF FACILITIES		
4.01.00	Bidders may note that this is a turnkey contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.		
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 1 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following : a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976, (p.) Gas Cylinder Rules, 1981			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 2 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
5.02.00	(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981 (r.) Workmen's Compensation Act, 1923 (s.) Workmen's Compensation Rules, 1924 (t.) NTPC Safety Rules for Construction and Erection (u.) NTPC Safety Policy (v.) Any other statutory codes / standards / regulations, as may be applicable. Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply : a) Bureau of Indian standards (BIS) b) Japanese Industrial Standards (JIS) c) American National Standards Institute (ANSI) d) American Society of Testing and Materials (ASTM) e) American Society of Mechanical Engineers (ASME) f) American Petroleum Institute (API) g) Standards of the Hydraulic Institute , U.S.A. h) International Organization for Standardization (ISO) i) Tubular Exchanger Manufacturer's Association (TEMA) j) American Welding Society (AWS) k) National Electrical Manufacturers Association (NEMA) l) National Fire Protection Association (NFPA) m) International Electro-Technical Commission (IEC) n) Expansion Joint Manufacturers Association (EJMA) o) Heat Exchange Institute (HEI) p) IEEE standard		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 3 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.03.00 5.04.00 5.05.00 5.06.00 5.07.00 5.08.00 6.00.00 6.01.00	q) JEC standard Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English. As regards highly standardised equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered. In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern. Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award. In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect. A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification. EQUIPMENT FUNCTIONAL GUARANTEE The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 4 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS			
7.01.00	DESIGN OF FACILITIES			
	All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.			
7.02.00	MAINTENANCE AND AVILABILITY CONSIDERATIONS			
	Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 5 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is a turnkey contract. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works. The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification. A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.			
8.02.00	The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification.			
8.03.00	The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:			
8.03.01	A) BASIC ENGINEERING DOCUMENTATION Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. iv) Optimisation studies including thermal cycle optimisation. v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 6 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups. vii) Water Balance diagram. viii) Operation Philosophy and the control philosophy of the Main Plant and other plants. ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope. x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder. xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer. B) DETAILED ENGINEERING DOCUMENTS i) General layout plan of the station. ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii) Flow diagram, process and instrumentation diagrams along with write up and system description. iv) Start up curves for boiler and both turbines and boiler combined together as a unit for various start ups, viz. cold, warm and hot start up. v) Piping isometric, composite layout and fabrication drawings. vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 7 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors. viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans, BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc. ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier. x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.. xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.). xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters. xiii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc. xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xv) Protection system diagrams and relay settings. xvi) Cables schedules and interconnection diagrams. xvii) Cable routing plan. xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 8 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
8.03.02	xx) Sequence and protection interlock schemes. xxi) Type test reports, insulation co-ordination study report and power system stability study report. xxii) Control system configuration diagrams and card circuit diagrams and maintenance details. xxiii) Detailed DDCMIS system manuals. xxiv) Detailed flow chart for digital control system. xxv) Mimic diagram layout, Assignment for other application engg. xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. xxvii) Underground facilities, levelling ,sanitary, land scaping drawings. xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable. xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. The Contractor's while sumitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made. INSTRUCTION MANUALS The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 9 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection. c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 10 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows : 1) <u>Chapter 1 - Plant Description</u> : To contain the following sections specific to the equipment/system supplied (a) Description of operating principle of equipment / system with schematic drawing / layouts. (b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared. (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 11 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures. (i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure. 3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 12 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
8.03.03	(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied. After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O & M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 13 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C. iv) Contractor shall prepare the model of all the facilities located in Main Power Block area, covering Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area and any other facility located in Main Plant Block area in an integrated & intelligent 3D software solution using rule based, data centric 3D design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer. After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the employer for its reference.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 15 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract. The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project . The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 16 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this turnkey package. Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. j) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per Annexure VI. k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 17 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
8.04.00	completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule. m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing. ENGINEERING INFORMATION SUBMISSION SCHEDULE Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts. i) Information that shall be submitted for the approval to the Employer before proceeding further, and ii) Information that would be submitted for Employer's information only. The Master Drawing List(MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 18 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
8.05.00 8.05.01 8.05.02 8.05.03	Engineering Co-ordination Procedure The following principal coordinators will be identified by respective organizations at time of award of contract : NTPC Engineering Coordinator (NTPC EC) : Name : _____ Designation : _____ Address : _____ a) Postal : _____ b) Telegraphic / e-Mail : _____ c) FAX : _____ TELEPHONE : _____ Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : _____ Designation : _____ Address : _____ a) Postal : _____ b) Telegraphic / e-Mail : _____ c) FAX : _____ TELEPHONE : _____ All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations. Contractor's/Vendor's Drawing Submission and Approval Procedure : a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 19 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance. d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number. e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories : CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 20 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents. i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.			
8.06.00	ENGINEERING PROGRESS AND EXCEPTION REPORT			
8.06.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 21 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
8.06.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.		
9.00.00	TECHNICAL CO-ORDINATION MEETING		
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.		
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.		
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.		
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.		
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.		
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 22 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.		
11.00.00	EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.		
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.		
13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS		
13.01.00	All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H ₂ , CO ₂ and N ₂ for generator) and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in india are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder scope shall also include supply of H ₂ , CO ₂ and N ₂ as applicable for the generator till successful commissioning of generator. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.		
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.		
14.00.00	LUBRICATION		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 23 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.			
15.00.00	MATERIAL OF CONSTRUCTION			
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.			
16.00.00	RATING PLATES, NAME PLATES & LABELS			
16.01.00	Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.			
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.			
16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.			
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.			
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire.			
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 24 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 25 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION			
	All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.			
20.02.00	PRESERVATIVE SHOP COATING			
	All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.			
	Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.			
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.			
20.04.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.			
20.05.00	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 26 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
20.06.00	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.			
21.00.00	QUALITY ASSURANCE PROGRAMME			
21.01.00	To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 27 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.			
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)			
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).			
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 28 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning. 22.05.00 The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. 22.06.00 The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities. 22.07.00 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). 22.08.00 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details 22.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing. 22.10.00 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. 22.11.00 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 29 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract. 22.19.00 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance. 22.20.00 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan. 22.21.00 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc. 22.22.00 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable. 22.23.00 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative. 22.24.00 Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 31 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	contractor / sub – contractor should meet the following. 1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. <u>Elevated Temperature Test Cycle</u> During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. 2) <u>Burn in Test Cycle</u> The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the system shall		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 32 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
22.25.00	be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature. The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.		
23.00.00	QUALITY ASSURANCE DOCUMENTS		
23.01.00	The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.		
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.		
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 33 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	(e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC			
23.03.00	Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
23.04.00	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review. (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release. (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. (c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 34 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
23.05.00	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.			
24.00.00	PROJECT MANAGER’S SUPERVISION			
24.01.00	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of ‘Arbitration’ clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.			
24.02.00	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: (a.) Interpretation of all the terms and conditions of these documents and specifications: (b.) Review and interpretation of all the Contractor’s drawing, engineering data, etc: (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer’s works or at site, or at any place where work is performed under the contract : (d.) Inspect, accept or reject any equipment, material and work under the contract : (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 35 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
25.00.00 25.01.00 25.02.00 25.03.00 25.04.00 25.05.00 25.06.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection. The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract. When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract. In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 36 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.		
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.		
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.		
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.		
25.10.00	Associated document for Quality Assurance programme		
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I.		
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.		
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).		
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.		
25.10.05	Field Welding Schedule Format enclosed at Annexure-V.		
25.11.00	TESTING OF MAJOR DESIGN FEATURES: The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 37 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following. a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B. b) Loop reaction time for sample loops/ logics. c) SOE functionality tests. d) Server changeover. e) Various response times, having serious implication on operation & maintenance philosophy. f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load. g) Unified HMI for DDCMIS. The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer. If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report. 25.12.00 DEMONSTRATION OF APPLICATION ENGINEERING 25.12.01 Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 38 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.			
	(ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports. e) Calculations (Basic & Performance Calculations).			
25.12.02	The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings. After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES			
26.01.00	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 39 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
26.01.00	commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications. (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness. (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable. Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain : (1.) Biodata including experience of the Commissioning Engineers. (2.) Role and responsibilities of the Commissioning Organisation members. (3.) Expected duration of posting of the above Commissioning Engineers at site.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 40 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
26.02.00	Initial Operation (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours. The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility. The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. (c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.		
26.03.00	Guarantee Tests a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 41 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	conduct such test. Such test will be commenced, within a period of three (3) months after the successful completion of Initial Operations. Any extension of time beyond the above three (3) months shall be mutually agreed upon. b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost. e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.			
27.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests, other than Guarantee Tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.			
28.00.00	TRAINING OF EMPLOYER'S PERSONNEL			
28.01.00	The scope of service under training of Employer's engineers shall include a training module covering the areas of Operation & Maintenance. Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer: (a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments. (b) Training for Electric Systems including VFD and Electric power supply system.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 42 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
28.03.00	(c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc. (d) Training for special packages for various PC based systems specified elsewhere in Part-B of Technical Specification, Section-VI. (e) Training for various C&I systems/equipment supplied includes the following: i) DDCMIS - Human Machine Interface – Hardware & Operating System ii) DDCMIS-Human Machine Interface System Engineering & Application Software. iii) DDCMIS – Control System Hardware and Control system Application Software. iv) DDCMIS – Operator Training : Use of the system at Works + at site. v) DDCMIS – Specialized Network security. (f) Training for power cycle piping/critical piping. (g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system. (h) Training for numerical relays & networking systems supplied under MV & LT switchgear system. (i) Training for Simulator System (j) Details of training modules for SG, TG, Electrical, C&I systems and Simulator System are given at Annexure – VII, VIII, IX, X, XI & XII. The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval. The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering a training module as indicated in Annexure – VII, VIII, IX, X, XI & XII . This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product deign software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 43 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	problems which may be encountered in fabrication, manufacturing erection, welding etc.			
28.04.00	Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.			
28.05.00	Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above [i.e. Annexure – VII, VIII, IX, X, XI & XII for O&M and Engineering] is indicative only. Employer reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.			
28.06.00	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.			
28.07.00	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.			
28.08.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.			
	Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.			
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION			
	In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:			
	i) Working platforms should be fenced and shall have means of access.			
	ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.			
30.00.00	NOISE LEVEL			
	The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS
				PAGE 44 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA. ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA. iii) Mill noise which will be limited to 85-90 dBA. iv) TG unit in which case it shall not exceed 90 dBA. v) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA. vi) For BFP Motor Noise level shall be with in the limit of 90 dBA.		
31.00.00	PACKAGING AND TRANSPORTATION All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.		
32.00.00	ELECTRICAL EQUIPMENTS/ENCLOSURES		
32.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.		
33.00.00	INSTRUMENTATION AND CONTROL		
	All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.		
33.01.00	All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 45 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS																					
	All scales and charts shall be calibrated and printed in Metric Units as follows: <table><tr><td>1. Temperature</td><td>- Degree centigrade (deg C)</td></tr><tr><td>2. Pressure</td><td>- Kilograms per square centimetre (Kg/cm²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.</td></tr><tr><td>3. Draught</td><td>- Millimetres of water column (mm wc).</td></tr><tr><td>4. Vacuum</td><td>- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).</td></tr><tr><td>5. Flow (Gas)</td><td>- Tonnes/ hour</td></tr><tr><td>6. Flow (Steam)</td><td>- Tonnes/ hour</td></tr><tr><td>7. Flow (Liquid)</td><td>- Tonnes / hour</td></tr><tr><td>8. Flow base</td><td>- 760 mm Hg. 15 deg.C</td></tr><tr><td>9. Density</td><td>- Grams per cubic centimetre.</td></tr></table>				1. Temperature	- Degree centigrade (deg C)	2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.	3. Draught	- Millimetres of water column (mm wc).	4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).	5. Flow (Gas)	- Tonnes/ hour	6. Flow (Steam)	- Tonnes/ hour	7. Flow (Liquid)	- Tonnes / hour	8. Flow base	- 760 mm Hg. 15 deg.C	9. Density	- Grams per cubic centimetre.
1. Temperature	- Degree centigrade (deg C)																					
2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.																					
3. Draught	- Millimetres of water column (mm wc).																					
4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).																					
5. Flow (Gas)	- Tonnes/ hour																					
6. Flow (Steam)	- Tonnes/ hour																					
7. Flow (Liquid)	- Tonnes / hour																					
8. Flow base	- 760 mm Hg. 15 deg.C																					
9. Density	- Grams per cubic centimetre.																					
33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.																					
33.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.																					
34.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).																					
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 46 OF 111																		

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
35.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.		
36.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.		
37.00.00	TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor. i) Temperature test pockets with stub and thermowell ii) Pressure test pockets		
38.00.00	SYSTEM DOCUMENTATION The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 47 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage. 38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer. 39.00.00 MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two(2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him.The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 48 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
	IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958)	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 49 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
			(ISO/R-65-1958) (BS 1387 : 1957) IS:1239 Part-II Mild steel tubulars and other wrought steel pipe fittings BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965 IS:2825 Code for unfired vessels IS:1520 Horizontal centrifugal pumps for clear cold and fresh water IS:1600 Code for practice for performance of constant speed IC Engines for general purpose IS:1601 Specification for performance of constant speed IC Engines for general Purpose IS:1893 Criteria for earthquake resistant design of structures IS1978-1971 Line Pipe April 1969. API Standards 5L IS:2254-1970 Dimensions of vertical shaft motor for pumps IEC Pub 72-1 part I NEMA Pub MG 1 1954 IS:2266 Steel wire ropes for general engineering purposes BS :302 : 1968 IS:2312 Propellant type Ventilation fans IS:2365 Steel wire suspension ropes for lifts and hoists BS : 1957 IS:3346 Method for the determination of thermal DIN 52612 (Deutscher Normenausschuss)	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 50 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		conductivity of thermal insulation materials (two slab guarded hot plate method) IS:3354 Outline dimensions for electric lifts. IS:3401 Silica gel IS:3588 Specification for electrical axial flow fans IS:3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diameter) IS:3677 Unbonded rock and slag wool for thermal insulation IS:3815 Point hook with shank for general engineering purposes IS:3895 Specification for monocrystalline semiconductor rectifier cells and stacks IS:3963 Roof extractor unit IS:3975 Mild steel wires, strips and tapes for armouring cables IS:4503 Shell and tube type heat Exchanger IS:4540 Specification for monocrystalline rectifier assembly	ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963 BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 51 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		equipment		
	IS:4671	Expanded polystyrene for thermal insulation purpose		
	IS:4736	Hot dip zinc coating on steel tubes		
	IS:4894	Centrifugal fans		
	IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)		
	IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958	
	IS:6392	Steel pipe flanges	BS 4504 : 1969	
	IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956	
	IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
	IS:7373	Specification for wrought aluminium and aluminium sheet and strips		
	IS:7938	Air receivers for compressed air installation		
	ISO:1217	Displacement compressor-Acceptance test		
	ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling		
	ASHRAE-52-76 particle matter.	Air cleaning device used in general ventilation for removing		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 52 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 Fans (Part-1,2) BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 53 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guide lines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners. IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 54 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	(Part-II) Calcined clay based. IS: 1542 Specification for sand for plaster. IS: 1566 Specification for hard-drawn steel wire fabric for concrete reinforcement. IS: 1786 Specification for high strength deformed bars for concrete reinforcement. IS: 2062 Specification for steel for general structural purposes. IS: 2116 Specification for sand for masonry mortars. IS: 2386 (Parts-I to VIII) Testing of aggregates for concrete. IS: 3150 Hexagonal wire netting for general purpose. IS: 3495 (Parts-I to IV) Methods of tests of burnt clay building bricks. IS: 3812 Specification for fly ash, for use as pozzolana and admixture. IS: 4031 Methods of physical tests for hydraulic cement. IS: 4032 Methods of chemical analysis of hydraulic cement. IS: 4082 Recommendations on stacking and storage of construction materials at site. IS: 8112 Specification for 43 grade ordinary portland cement. IS: 8500 Medium and high strength structural steel. IS: 12269 53 grade ordinary portland cement. IS: 12894 Specification for Fly ash lime bricks. Cast-In-Situ Concrete and Allied Works IS: 280 Specification for mild steel wire for general engineering purposes. IS: 456 Code of practice for plain and reinforced concrete.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 55 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 457 IS: 516 IS: 650 IS: 1199 IS: 1791 IS: 1838 (Part-I) IS: 2204 IS: 2210 IS: 2438 IS: 2502 IS: 2505 IS: 2506 IS: 2514 IS: 2645 IS: 2722 IS: 2750 IS: 2751 IS: 3025 IS: 3366 IS: 3370	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. Method of test for strength of concrete. Specification for standard sand for testing of cement. Methods of sampling and analysis of concrete. General requirements for batch type concrete mixers. Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type). Code of practice for construction of reinforced concrete shell roof. Criteria for the design of reinforced concrete shell structures and folded plates. Specification for roller pan mixer. Code of practice for bending and fixing of bars for concrete reinforcement. General requirements for concrete vibrators, immersion type. General requirements for concrete vibrators, screed board type. Specification for concrete vibrating tables. Specification for Integral cement water proofing compounds. Specification for portable swing weigh batches for concrete. (single and double bucket type) Specification for Steel scaffolding. Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction. Methods of sampling and test waste water. Specification for Pan vibrators. Code of practice for concrete structures for the storage of		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS
		PAGE 56 OF 111		

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(Part I to IV) IS: 3414 IS: 3550 IS: 3558 concrete. IS: 4014 (Parts I & II) IS: 4326 of buildings. IS: 4461 IS: 4656 IS: 4925 IS: 4990 IS: 4995 (Parts I & II) IS: 5256 IS: 5525 concrete work. IS: 5624 IS: 6461 IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103	liquids. Code of practice for design and installation of joints in buildings. Methods of test for routine control for water used in industry. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earthquake resistant design and construction of buildings. Code of practice for joints in surface hydro-electric power stations. Specification for form vibrators for concrete. Specification for batching and mixing plant. Specification for plywood for concrete shuttering work. Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. Code or practice for sealing joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete work. Specification for foundation bolts. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 57 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 9417 IS: 10262 IS: 11384 IS: 11504 IS: 12118 IS: 12200 IS: 13311 Part-1 Part-2 SP:23 SP: 24 SP: 34	Recommendations for welding cold worked steel bars for reinforced concrete construction. Recommended guidelines for concrete mix design. Code of practice for composite construction in structural steel and concrete. Criteria for structural design of reinforced concrete natural draught cooling towers. Specification for two-parts poly sulphide. Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. Method of non-destructive testing of concrete. Ultrasonic pulse velocity. Rebound hammer. Handbook of concrete mixes Explanatory Handbook on IS: 456-1978 Handbook on concrete reinforcement and detailing. Precast Concrete Works SP: 7(PartVI/ National Building Code- Structural design of prefabrication and Sec.7) systems building. IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units. Masonry and Allied Works IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls. IS: 2212 Code of Practice for Brickwork.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 58 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 2250 SP: 20	Code of Practice for Preparation and use of Masonry Mortar. Explanatory hand book on masonry code.		
	Sheeting Works			
	IS:277	Galvanised steel sheets (plain or corrugated).		
	IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.		
	IS: 513	Cold-rolled carbon steel sheets.		
	IS: 730	Specification for fixing accessories for corrugated sheet roofing.		
	IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.		
	IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.		
	IS: 3007	Code of practice for laying of asbestos cement sheets.		
	IS: 5913	Methods of test for asbestos cement products.		
	IS: 7178	Technical supply conditions for tapping screw.		
	IS: 8183	Bonded mineral wool.		
	IS: 8869	Washers for corrugated sheet roofing.		
	IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.		
	IS: 12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).		
	IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.		
	Fabrication and Erection of Structural Steel Work			
	IS: 2016	Specification for plain washers.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS	PAGE 59 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.		
	IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.		
	IS: 3502	Specifications for chequered plate.		
	IS: 6911	Specification for stainless steel plate, sheet and strip.		
	IS: 3757	Specification for high strength structural bolts		
	IS: 6623	Specification for high strength structural nuts.		
	IS: 6649	High Tensile friction grip washers.		
	IS: 800	Code of practice for use of structural steel in general building construction.		
	IS: 816	Code of practice for use of Metal Arc Welding for General Construction.		
	IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.		
	IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.		
	IS: 817	Code of practice for Training and Testing of Metal Arc Welders.		
	IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).		
	IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.		
	IS: 9006	Recommended Practice for Welding of Clad Steel.		
	IS: 7215	Tolerances for fabrication steel structures.		
	IS: 12843	Tolerance for erection of structural steel.		
	IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.		
	SP: 6 (Part 1 to 7)	ISI Hand book for structural Engineers.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 60 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334 Plastering and Allied Works IS : 1635 IS : 1661 IS : 2333 IS : 2402 IS : 2547 IS : 3150 Acid and Alkali Resistant Lining IS : 158 IS : 412	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. Code of practice for Magnetic Particle Flaw Detection of Welds. Code of practice for field slaking of Building lime and preparation of putty. Application of cement and cement lime plaster finishes. Plaster-of-paris. Code of practice for external rendered finishes. Gypsum building plaster. Hexagonal wire netting for general purpose. Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. Specification for expanded metal steel sheets for general purpose.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 61 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS : 4441 IS : 4443 IS : 4456 IS : 4457 IS : 4832 IS : 4860 IS : 9510	Code of practice for use of silicate type chemical resistant mortars. Code of practice for use of resin type chemical resistant mortars. Method of test for chemical resistant tiles. (Part I & II) Specification for ceramic unglazed vitreous acid resistant tiles. Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type Specification for acid resistant bricks. Specification for bitumasitc, Acid resisting grade. Water Supply, Drainage and Sanitation IS : 458 IS : 554 IS : 651 IS : 774 IS : 775 IS : 778 IS : 781 IS : 782 IS : 783	Code of practice for use of silicate type chemical resistant mortars. Code of practice for use of resin type chemical resistant mortars. Method of test for chemical resistant tiles. (Part I & II) Specification for ceramic unglazed vitreous acid resistant tiles. Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type Specification for acid resistant bricks. Specification for bitumasitc, Acid resisting grade. Water Supply, Drainage and Sanitation Specification for concrete pipes. Dimensions for pipe threads, where pressure tight joints are made on thread. Specification for salt glazed stoneware pipes. Flushing cisterns for water closets and urinals. Cast iron brackets and supports for wash basins and sinks. Copper alloy gate, globe and check valves for water works purposes. Cast copper alloy screw down bib taps and stop valves for water services. Caulking lead. Code of practice for laying of concrete pipes.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 62 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS : 1172	Basic requirements for water supply, drainage and sanitation.		
	IS : 1230	Cast iron rain water pipes and fittings.		
	IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.		
	IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.		
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.		
	IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.		
	IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.		
	IS : 1726	Cast iron manhole covers and frames.		
	IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.		
	IS : 1742	Code of practice for building drainage.		
	IS : 1795	Pillar taps for water supply purposes.		
	IS : 1879	Malleable cast iron pipe fittings.		
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.		
	IS : 2065	Code of practice for water supply in building.		
	IS : 2326	Automatic flushing cisterns for urinals.		
	IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.		
	IS : 2501	Copper tubes for general engineering purposes.		
	IS : 2548	Plastic seat and cover for water-closets.		
	IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).		
	IS : 2963	Non-ferrous waste fittings for wash basins and sinks.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 63 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	IS : 3114 Code of practice for laying of cast iron pipes. IS : 3311 Waste plug and its accessories for sinks and wash basins. IS : 3438 Silvered glass mirrors for general purposes. IS : 3486 Cast iron spigot and socket drain pipes. IS : 3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). IS : 3989 Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. IS : 4111 (Part I to IV) Code of practice for ancillary structure in sewerage system. IS : 4127 Code of practice for laying of glazed stone-ware pipes. IS : 4764 Tolerance limits for sewage effluents discharged into inland-surface waters. IS : 4827 Electro plated coating of nickel and chromium on copper and copper alloys. IS : 5329 Code of practice for sanitary pipe work above ground for buildings. IS : 5382 Rubber sealing rings for gas mains, water mains and sewers. IS : 5822 Code of practice for laying of welded steel pipes for water supply. IS : 5961 Cast iron grating for drainage purpose. IS : 7740 Code of practice for road gullies. IS : 8931 Cast copper alloy fancy bib taps and stop valves for water services. IS : 8934 Cast copper alloy fancy pillar taps for water services. IS : 9762 Polyethylene floats for ball valves. IS : 10446 Glossary of terms for water supply and sanitation.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 64 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS : 10592	Industrial emergency showers, eye and face fountains and combination units.		
	IS : 12592	Specification for precast concrete manhole covers and frames.		
	IS : 12701	Rotational moulded polyethylene water storage tanks.		
	SP: 35	Hand book on water supply and drainage.		
	-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.		
	Doors, Windows and Allied Works			
	IS : 204	Tower Bolts		
	Part-I	Ferrous metals.		
	Part-II	Nonferrous metals.		
	IS : 208	Door Handles.		
	IS : 281	Mild steel sliding door bolts for use with padlocks.		
	IS : 362	Parliament Hinges.		
	IS : 420	Specification for putty, for use on metal frames.		
	IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.		
	IS : 1038	Steel doors, windows and ventilators.		
	IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.		
	IS : 1341	Steel butt hinges.		
	IS : 1361	Steel windows for industrial buildings.		
	IS : 1823	Floor door stoppers.		
	IS : 1868	Anodic coatings on Aluminium and its alloys.		
	IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 65 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS:2209	Mortice locks (vertical type).		
	IS:2553	Safety glass		
	IS:2835	Flat transparent sheet glass.		
	IS:3548	Code of practice for glazing in buildings.		
	IS:3564	Door closers (Hydraulically regulated).		
	IS : 3614	Fire check doors; plate, metal covered and rolling type.		
	IS:4351	Steel door frames.		
	IS:5187	Flush bolts.		
	IS:5437	Wired and figured glass		
	IS:6248	Metal rolling shutters and rolling grills.		
	IS:6315	Floor springs (hydraulically regulated) for heavy doors.		
	IS:7196	Hold fasts.		
	IS:7452	Hot rolled steel sections for doors, windows and ventilators.		
	IS:10019	Mild steel stays and fasteners.		
	IS:10451	Steel sliding shutters (top hung type).		
	IS:10521	Collapsible gates.		
	R oof Water Proofing and AlliedWorks			
	IS:1203	Methods of testing tar and bitumen.		
	IS:1322	Specification for bitumen felts for water proofing and damp proofing.		
	IS:1346	Code of practice for water proofing of roofs with bitumen felts.		
	IS:1580	Specification for bituminous compound for water proofing and caulking purposes.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 66 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3067 Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings. IS:3384 Specification for bitumen primer for use in water proofing and damp proofing. Floor Finishes and Allied Works IS:1237 Specification for cement concrete flooring tiles. IS:1443 Code of practice for laying and finishing of cement concrete flooring tiles. IS:2114 Code of practice for laying in-situ terrazzo floor finish. IS:2571 Code of practice for laying in-situ cement concrete flooring. IS:3462 Specification for unbacked flexible PVC flooring. IS:4971 Recommendations for selection of industrial floor finishes. IS:5318 Code of practice for laying of flexible PVC sheet and tile flooring. IS:8042 Specification for white portland cement. IS:13801 Specification for chequered cement concrete flooring tiles. Painting and Allied Works IS:162 Specification for fire resisting silicate type, brushing, for use on wood, colour as required. IS:1477 Code of practice for painting of ferrous metals in buildings. Part-I Pretreatment. Part-II Painting. IS:1650 Specification for colours for building and decorative finishes. IS:2074 Specification for red oxide-zinc chrome, priming, ready mixed paint air drying. IS:2338 Code of practice for finishing of wood and wood based materials. Part-I Operations and workmanship			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 67 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Part-II IS:2395 Part-I Part-II IS:2524 Part-I Part-II IS:2932 IS:2933 IS:4759 IS:5410 IS:5411 (Part-I) IS:6278 IS:10403 Piling and Foundation IS:1080 IS:1904 IS:2911 IS:2950 IS:2974 (Part-I TO V) IS:6403	Schedules Code of practice for painting concrete, masonry and plaster surfaces. Operations and workmanship. Schedule. Code of practice for painting of nonferrous metals in buildings. Pretreatment. Painting. Specification of synthetic enamel paint, exterior, under-coating and finishing. Specification enamel paint, under coating and finishing. Code of practice for hot dip zinc coating on structural steel and other allied products. Specification for cement paint Specification for plastic emulsion paint-for exterior use Code of practices for white washing and colour washing. Glossary of terms relating to building finishes. Piling and Foundation Code of practice for design and construction of simple spread foundations. Code of practice for design and construction of foundations in Soils; General Requirements. Code of practice for designs and construction of Pile foundations (Relevant Parts). Code of practice for designs and construction of Raft (Part-I) foundation. Code of practice for design and construction of machine foundations. Code of practice for determination of Allowable Bearing pressure on Shallow foundation.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 68 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS:8009 Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Part-I Shallow foundations. Part-II Deep foundations. IS:12070 Code of practice for design and construction of shallow foundations on rocks. DIN:4024 Flexible supporting structures for machines with rotating machines. VDI:2056 Criteria for assessing mechanical vibrations of machines. VDI:2060 Criteria for assessing rotating imbalances in machines. Stop Log and Trash Rack IS:4622 Recommendations for fixed - wheel gates structural design. IS:5620 Recommendations for structural design criteria for low head slide gates. IS:11388 Recommendations for design of trash rack for intakes. IS:11855 General requirements for rubber seals for hydraulic gates. Roads IRC:5 Standard specifications and Code of practice for road bridges, section-I general Features of Design. IRC:14 Recommended practice of 2cm thick bitumen and tar carpets. IRC:16 Specification for priming of base course with bituminous primers. IRC:19 Standard specifications and code of practice for water bound macadam. IRC:21 Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced). IRC:34 Recommendations for road construction in waterlogged areas. IRC:36 Recommended practice for the construction of earth embankments for road works. IRC:37 Guidelines for the Design of flexible pavements. IRC:56 Recommended practice for treatment of embankment slopes for erosion control. IRC:73 Geometric design standards for rural (non-urban) highways. IRC:86 Geometric Design standards for urban roads in plains.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 69 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IRC:SP:13 Guidelines for the design of small bridges & culverts. IRC - Public- Ministry of Surface Transport (Roads Wing), Specifications ation for road and bridge works. IS:73 Specification for paving bitumen Loadings IS:875 Code of practice for design loads other than earthquake) for (Pt. I to V) buildings and structures. IS:1893 Criteria for earthquake resistant design of structures. IS:4091 Code of Practice for design and construction of foundation for transmission line towers & poles. IRC:6 Standard specifications & code of practice for road bridges, Section-II Loads and stresses. M.O.T. Deptt. of railways Bridge Rules. Safety IS:3696 Safety code for scaffolds and ladders. (Part I & II) IS:3764 Safety code for excavation work. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Safety code for demolition of buildings. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection on structural steelwork. IS:7293 Safety code for working with construction machinery. IS:7969 Safety code for handling and storage of building materials IS:11769 Guidelines for safe use of products containing asbestos. - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings)		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 70 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Criteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements - Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electrical Resistance thermometers - IS:2806. - Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements - Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). - Electronic transmitters BS:6447. - Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. - Process operated switch devices (Pr. Switch) BS-6134.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 71 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. - Dynamic response testing of process control instrumentation ISA - S 26 (1968). - Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. - Printed circuit boards - IPC TM - 650, IEC 326 C. - General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. - Edge socket connectors - IEC 130-11. - Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. - Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). - Direct acting electrical indicating instrument - IS:1248 - 1968 (R). - Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. - Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. - Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. - Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 72 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987. 22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984. Instrument Switches and Contact 1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000. 2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600. Enclosures 1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13). 2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972). 3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962. Apparatus, enclosures and installation practices in hazardous area 1. Classification of hazardous area - NFPA 70 - 1984, Article 500. 2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973. 3. Intrinsically safe apparatus - NFPA 493 1978. 4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982. 5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 73 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Sampling System 1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316. 2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977. 3. Water and steam in power cycle - ASME PTC 19.11. 4. Standard methods of sampling system - ASTM D 1066-99. Annunciators 1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979. 2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472 3. Damp heat cycling test - IS:2106 4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78 Protections 1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989. 2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973. 3. Turbine water damage prevention - ASME TDP-1-1980. 4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991. UPS System 1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. 2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. 3. Surge withstand capability test - ANSI C 37.90 1 -1989. 4. Performance testing of UPS - IEC 146. 5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 74 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. 7. Printed Circuit Board - IPC TM 650, IEC 326C. 8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973. Control Valves 1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985. 2. Face to face dimensions of control valves - ANSI B 16.00 - 1973. 3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). 4. Codes for pressure piping - ANSI B 31.1 5. Control Valve leak class - ISA RP 39.6 Process Connection & Piping 1. Codes for pressure piping "power piping" - ANSI B 31.1. 2. Seamless carbon steel pipe ASTM - A - 106. 3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. 4. Material for socket welded fittings - ASTM - A - 105. 5. Seamless ferritic alloy steep pipe - ASTM - A - 335. 6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. 7. Composition bronze of ounce metal castings - ASTM - B - 62. 8. Seamless Copper tube, bright annealed - ASTM - B - 168. 9. Seamless copper tube - ASTM - B - 75. 10. Dimension of fittings - ANSI - B - 16.11. 11. Valves flanged and butt welding ends - ANSI - B - 16.34. Instrument Tubing 1. Seamless carbon steel pipe - ASTM - A 106. 2. Material of socketweld fittings - ASTM - A105. 3. Dimensions of fittings - ANSI - B - 16.11.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 75 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. Cables 1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. 2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815. 3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83. 4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6). 5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977. 6. Rules for Testing insulated cables and flexible cables : VVDE - 0472 7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980) 8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81. 9. Oxygen index and temperature index test - ASTM D - 2863. 10. Smoke density measurement test - ASTM D - 2843. 11. Acid gas generation test - IEC - 754 - 1. 12. Swedish Chimney test - SEN - 4241475 (F3). 13. Teflon (FEP) insulation & sheath test - ASTM D - 2116. 14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784. 15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I). Cable Trays, Conduits 1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984. 2. -do- Test Standards. NEMA VE-1-1979. 3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 76 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Public Address System - Specifications for loud speakers - IS:7741 (Part-I, II and III) - Code of safety requirement for electric mains operated audio amplifiers - IS:1301 - Specification for Public Address Amplifiers - IS:10426. - Code of practice for outdoor installation of PA system - IS:1982. - Code of practice for installation for indoor amplifying and sound distribution system - IS:1881. - Basic environmental testing procedures for electronic and electrical items - IS:9000. - Characteristics and methods of measurements for sound system equipment - IS:9302 - Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732 - Rigid steel conduits for electric wiring - IS:9537 (Part-I and II) - Fittings for rigid steel conduits for electrical wiring - IS:2667 - Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147. Vibration Monitoring System - API 670 - 1994 - BS : 4675 Part-2		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 77 OF 111

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV.NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N						M	C	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'	 FOR NTPC USE	DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER						
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL	

FORMAT NO.: QS-01-QAI-P-09/F1-R1

1/1

ENGG. DIV./QA&I

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO.: CS-9585-001-2	GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 111
---	--	-------------------------------	----------------

ANNEXURE-II

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV. NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	 FOR NTPC USE	DOC. NO.:		REV.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER						
SIGNATURE					REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F2-R1

1/1

ENGG. DIV./QA&I

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.: CS-9585-001-2	GENERAL TECHNICAL REQUIREMENT	PAGE 79 OF111
---	---	-------------------------------	---------------

ANNEXURE-III

	Project :	Stage ::	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL						DOC. NO.:	
	Package :								REV. NO.:	
	Supplier :								DATE :	
	Contractor No. :		SUB-SYSTEM :						PAGE : OF	

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS
SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.
DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.
NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”
QP/INSPN CATEGORY:
CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.
CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.
UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

ANNEXURE-IV

	Project :	Stage ::	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL						DOC. NO.:		
	Package :								REV. NO.:		
	Contractor :								DATE :		
	Contractor No. :								PAGE : OF		
S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
FORMAT						1/1	Engg. Div. / QA&I				

ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE							DOC. NO.:			
		Contractor :				(To be raised by the contractor)							REV. NO.:			
		Contractor No. :				Welding Code:							DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																
FORMAT						1/1						Engg. Div. / QA&I				

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																																								
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of CD ROMs/DVDs/Portable Hard Disk</th></tr><tr><td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td></tr><tr><td>First submission and submission with major changes</td><td></td><td></td></tr><tr><td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td></tr><tr><td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td></tr><tr><td>▪ P&ID (All sizes)</td><td>4</td><td>-</td></tr><tr><td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td>2</td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2">1</td></tr><tr><td>i) First Submission</td></tr><tr><td rowspan="2">5</td><td>Commissioning and Performance Test Procedure manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr></table>	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents			First submission and submission with major changes			▪ Layout (A0&A1 sizes)	4	-	▪ Other Drawings/Documents (A0&A1 sizes)	2	-	▪ P&ID (All sizes)	4	-	a) Final drawings/documents (Directly to site)	6	2	b) "As Built" Drawing/Documents (Directly to site)	6	2	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2	2	Erection Manual (Directly to site)	4 sets	2	3	Operation & Maintenance manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2	4	Plant Hand Book	1	1	i) First Submission	5	Commissioning and Performance Test Procedure manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2			
S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk																																																									
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents																																																											
	First submission and submission with major changes																																																											
	▪ Layout (A0&A1 sizes)	4	-																																																									
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-																																																									
	▪ P&ID (All sizes)	4	-																																																									
	a) Final drawings/documents (Directly to site)	6	2																																																									
	b) "As Built" Drawing/Documents (Directly to site)	6	2																																																									
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2																																																									
2	Erection Manual (Directly to site)	4 sets	2																																																									
3	Operation & Maintenance manual	1 set	--																																																									
	i) First Submission																																																											
	ii) Final Submission (Directly to site)	4 sets	2																																																									
4	Plant Hand Book	1	1																																																									
	i) First Submission																																																											
5	Commissioning and Performance Test Procedure manual	1 set	--																																																									
	i) First Submission																																																											
	ii) Final Submission (Directly to site)	4 sets	2																																																									
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 83 OF 111																																																								

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			
	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
	6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	—
		ii) Approved Copies (Direct to Site)	4 sets	2
	7	Project Completion Report (Directly to site)	6 sets	2
	8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	—
	9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	—
	10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc		
		i) For review/comment	1	—
		ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
	11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals		
		i) For review/comment	1 set	—
		ii) Approved copies (Direct to Site)	4 sets	2
	12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 84 OF 111

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
1.0	Steam Generator & Auxiliaries (Mechanical)													
1.1	Boiler	General famlarisatio n of supplied boiler	6 months	3	a) General Design, equipment, system and parameter famlarisation of supplied boiler i.e. features, design, operating parameters etc. b) Genaral Layout of boiler & ESP area, basic layout selection criteria, arrangement of pressure part, flue gas duct, coal pipe, bunker, valves, dampers, equipments, piping trestles etc.	Design office of the QSGM	3	1. Manufacturing of pressure parts 2. Welding processes 3. Testing Facilities 4. Product Development in process/ progress 5. Future plan for Technology induction 6. R&D work in progress	Manufacturer's works where the boilers of the subject project is being manufactured.	4	1. General Design, equipment, system and parameter famlarisation of operating boiler (visited) (which preferably should be simillar to supplied boiler) i.e. features, design, operating parameters. The palnt visit should include the following: a) Boiler each floor level walk through b) Visit to all the boiler auxiliaries location. c) Visit to BOP area. 2. Collection of Performance data of the plant	Operating plants in any country including India where same make with similar capacity boilers are under operation.	2	27
1.2	Boiler	Pressure parts	6 months	3	Basic theory/ concept, calculation with illustrative example, Design application, arrangement of following: 1. Thermal design and hydraulic circulation balance 2. Strength Calculation 3. Pressure Part arrangement, coil orientation and basis. 4. Tube metal temperature calculation, criteria for location of thermocouple. 5. Selection Creiteria for soot blower (i.e. location, nos. etc.)	Design office of the QSGM	3							9
1.3	Boiler	Performanc e	6 months	3	Basic concept, calculation of performance data with illustrative example (such as Heat Duty, boiler efficiency, predicted performance, NOX calculation, furnace sizing etc.) of offered boiler and its application to boiler design.	Design office of the QSGM	4							12
1.4	Boiler	Boiler System	6 months	3	a) Basic concept, Sizing calculation of following systems with illustrative examples alongwith details of criteria affecting the sizing calculation : 1. Air & Gas System (duct sizing, air & gas weight calculation, damper & gates sizing etc.) 2. Start up system (Circulation calculation, sizing and input data for SGWC pump etc.) 3. Fuel firing/ Combustion system (Sizing calculation of Pulveriser, feeders, burners, PA & Seal Air Fans etc.) 4. Fuel Oil firing system (Sizing calculation of HFO/ LFO pump, heater, strainers, pressure drop calculation etc.) 5. Draft System (sizing calculation of FD & ID Fans etc.) b) Impact of the above sizing calculation on the overall boiler design/ performance.	Design office of the QSGM	6							18

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of training	Location of training	No of days	Content of training	Location of training	No of days	Content of training	Location of training	No of days	
					c) Selection/ optimisation of above system from techno-economics point of view such as start up system: selection criteria for wet mode upto 30% or 40% BMCR flow etc. d) Selection/ Optimisation of various auxiliaries/ equipments covered under above systems from techno-economics point of view. Such as type & no. of fans (axial- single/ double stage), APH (Tri sector/ bisector APH), Mills etc.	Design office of the QSGM								
1.5	Boiler	General familiarisation of supplied SCR System	6 months	3	General Design, equipment, system and parameter familiarisation of supplied SCR system i.e. features, design, operating parameters etc.	Design office of the SCR System supplier	2	1. Manufacturing of Catalyst 2. Testing Facilities for Catalyst 3. Product Development in process/ progress	Manufacturer's works where the SCR Catalysts of the subject project is being manufactured.	1	1. General Design, equipment, system and parameter familiarisation of operating SCR System (visited) (which preferably should be similar to supplied boiler) i.e. features, design, operating parameters. The plant visit should include the following: a) SCR system each floor level walk through b) Visit to all the SCR system auxiliaries location including Ammonia Dosing system.	Operating plants in any country including India where same make with similar capacity SCR system are under operation.	1	12
1.6	Boiler	Ammonia Dosing System for SCR System	6 months	3	1. Basic theory/ concept. 2. Selection & Sizing calculation of Ammonia dosing system with illustrative examples for Compressors, Storage Tanks, Pumps, vaporisers, Air-NH3 mixers, Glycol-water heaters etc. 3. Familiarisation of Safety measures to be ensured for Storage & Using Ammonia. 4. Selection & Sizing Criteria for Safety equipments to be ensured as per Indian Regulations for Ammonia Handling	Design office of the SCR System supplier	2	4. Future plan for Technology induction 5. R&D work in progress						6
1.7	Boiler	Catalyst Modules for SCR System	6 months	3	1. Basic theory/ concept. 2. Selection criteria of catalyst 3. Sizing calculation of catalyst & calculation of performance data (i.e. Activity etc.) with illustrative examples	Design office of the SCR System supplier	1				2. Collection of Performance data of the plant			3
1.8	Boiler	FGD System	6 months	3	1. Mass balance, Design, selection and sizing calculations of FGD 2. Training on factors affecting sizing/ efficiency of FGD system, equipments & auxiliaries 3. Materials for FGD & selection 4. Basic concepts, Design and sizing calculations on slurry systems including piping, valves, etc. 5. Layout & model of FGD area, cable & piping trestles etc. 6. Erection strategies, erection procedures. 7. Performance as per applicable code and demonstration tests.	Design office of the FGD System supplier	5	1. Manufacturing process of Absorber and other equipment 2. Welding process 3. Testing facilities 4. Product development in process 5. Future plan for technology induction 6. R&D work in progress.	Manufacturer's works where FGD system equipment of the subject project are being manufactured.	2	1. Familiarization with various system and equipment 2. Performance, data collection analysis and review 3. O&M feed back 4. Operation history of various equipment and system 5. Failure analysis	Operating plants in any country including India where same type with similar capacity FGD system are under operation.	3	30
1.9	Boiler	Buck stay & structure	6 months	3	Basic theory, calculations with illustrative example & Design application of Buck stay & structure design	Design office of the QSGM	2							6
1.10	Boiler	Erection & PG Test	6 months	3	Erection strategies, erection procedures Performance and demonstration tests.	NTPC PMI	2							6

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
1.11	Boiler	Review & discussion after Plant Visit	6 months	3	1. Analysis and review of collected performance data of the plant visited. 2. Co-relation of the operating plant design, parameter visited wrt to boiler supplied under contract. 3. O&M feedback of the plant 5. Failure analysis: Atleast elaborative case study of one major failure	NTPC PMI	2							6
1.12	Boiler Auxiliaries	Equipments /Auxiliaries	6 months		Selection criteria of auxiliaries (Type, Model, Nos. etc.) based on input data, design features, working & importance of	NTPC PMI			Manufacturer's works where the equipment of the subject project is being manufactured.					
				2	1. Coal pulveriser		2	Visit to manufacturer Works		1			6	
				2	2. Fans (ID, FD, PA & Seal Air Fans)		2	Visit to manufacturer Works		1			6	
				2	3. Air-preheater		2	Visit to manufacturer Works		1			6	
				2	4. Soot Blowers		1						2	
				2	5. Dampers & Gates		1						2	
				2	6. Valves including safety valves		2						4	
				2	7. Feeder		1						2	
				2	8. Burner		1						2	
				2	9. SG WC pump		1						2	
				2	10. Fuel Oil (HFO & LFO) Pumps, Heaters, Strainers etc.		2						4	
				2	11. Any other equipment/ auxiliaries not specified above		1						2	
Steam Generator & Auxiliaries (Mechanical) TOTAL Mandays		173				128			27			18	173	

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	

2.0	Steam Generator & Auxiliaries (Power Cycle Piping)													
2.1	Power Cycle Piping	Stress analysis of piping	6months	4	1. Critical pipe sizing including pressure drop calculation	Design office of the QSGM	2	1. Familiarisation of manufacturing/ fabrication/testing of critical piping (including welding techniques & heat treatment methods employed) and norms	Manufacturer's works	2	Familiarisation of Power cycle piping & equipment layout	Operating plants in any country including India operating on similar parameters	1	20
2.2	Power Cycle Piping			4	2.Static analysis of critical piping system	Design office of the QSGM	2	2. Familiarisation of variable & constant load hanger setting & snubber setting	Manufacturer's works	1				12
2.3	Power Cycle Piping			4	3.Dynamic analysis (safety valve blowing, wind, siesmic & steam hammer) of critical piping	Design office of the QSGM	2							8
2.4	Power Cycle Piping			4	4.Familiarisation of Hanger engineering	Design office of the QSGM	1							4
2.5	Power Cycle Piping			4	5.Familiarisation of piping vibration analysis & norms	Design office of the QSGM	1							4
POWER CYCLE PIPING TOTAL Mandays		48		4			32			12			4	48

3.0	Steam Generator & Auxiliaries (Electrical)													
3.1	Boiler	Electrical	6 months	3	Integral Actuator	Manufacturer Works	3	1. Design,interface and funtional aspect 2. Familiarisation with various types of actuator	Manufacturer Works	2				15
3.2	Boiler	Electrical	6 months	3	BCW motor	Manufacturer Works	3	1. Design review , manufacturing process, preservation. 2. operation and maintenance,preservatio n during storage	Manufacturer Works	2				15
3.3	Boiler	Electrical	6 months	3	HT Motor	Manufacturer Works	3	Design review , manufacturing process, storage.	Manufacturer Works	2				15
Electrical TOTAL Mandays		45		3			27			18			0	45

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
4.0	Steam Generator & Auxiliaries (Control & Instrumentation)													
4.1	C&I	SG-DDCMIS- Hardware and Operating System	18 months	4	(a) Hardware & Software organization of the system (b) Basis of selection of H/W memory sizing (c) Operating System features (d) Interface with other system, Openness and inter-operability (e) Upgradability and System testing features	SG-DDCMIS vendor works	2	(a) Hardware & Software organization of the system (b) Basis of selection of H/W memory sizing (c) Operating System features (d) Interface with other system, Openness and inter-operability (e) Upgradability and System testing features	SG-DDCMIS vendor works	2	Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1.5	22
4.2	C&I	SG-DDCMIS- Human Machine Interface System Engineering & Application Software	18 months	5	(a) Specific system customization (b) Various system modules & interface with OS © Database organisation & development (d) Development of mimics, other applications like calculations, logs, historical storage functionalities & use	SG-DDCMIS vendor works	4	Hands on experience, Testing methodologies	SG-DDCMIS vendor works	2	Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1	35
4.3	C&I	SG-DDCMIS- (i) Control system hardware (ii) Control system Application Software	18 months	4	(i) (a) Basic design features for system & its Modules, (b) System capabilites & system design techniques (c) Communication with HMI & other systems	SG-DDCMIS vendor works	4	(a) Manufacturing processes with special attention to handling of the modules (b)	SG-DDCMIS vendor works	1	Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in	1	24
				4	(ii) (a) Database structure (b) Organization & interface between application program & database(c) Application for implementation of Control functions (d) Study of standard algorithms & development of new algorithm	SG-DDCMIS vendor works	3	(ii) (a) System integration & system capabilites testing	SG-DDCMIS vendor works	1				16
4.4	C&I	Boiler Controls: (i) Study of Control loops (ii) Burner Manageme nt system	20 months	4	(i) (a) General concept of closed loop controls of the OEM (b) Critical analysis of some important control loops like Boiler Start up control, Feedwater control etc.	Design office of the QSGM	3				Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1	16
				4	(ii) (a) Hardware logic (b) NFPA-85/ EN-50156/ EN-61508/ En-61511 requirements and other applicable safety standards (c) Flame scanner locations.	Design office of the QSGM	4							16
4.5	C&I	Special SG- related instrumenta tion (i) Flame Scaneers (ii) Boiler Flame viewing system(iii) Acoustic	24 months	2	(i) (a) Flame scanners: Principle of Operation (b) Suitability for the proposed boiler	Flame scanner vendor's work	1	Manufacturing & testing procedures	Flame scanner vendor's work	1	Operational feedback	Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1	6
				2	(ii) (a) Boiler Flame viewing system: Principle of operation (b) Location (c) Details of software & methods of modification/ customization	Flame camera vendor's work	1				Operational feedback	Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1	4

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of training	Location of training	No of days	Content of training	Location of training	No of days	Content of training	Location of training	No of days	
		Pyrometer		2	(iii) (a) Acoustic Pyrometer: Principle of operation (b) Location (c) Details of software & methods of modification/ customization	Acoustic Pyrometer vendor's work	1				Operational feedback	Operating plants in any country including India where same make/ model of Acoustic Pyrometer is in operation.	1	4
4.6	C&I	Electric Power Supply System	22 months	2	System architecture and Component details	Electric power supply system vendor's work	2	Manufacturing/ assebling & testing procedures	Electric power supply system vendor's work	0.5				5
C&I TOTAL Mandays		148					94			29			25	148
5.0	Steam Generator & Auxiliaries (Quality Assurance)													
5.1	Quality Assurance & Inspection- QA System & Programme	QA System Procedure, Plant Standard	12 months	2	a) Integrated QAManagement System for enhanced reliability of equipments. b) QA system in design, procurement, manufacturing, installation and operation of equipments/ systems. c) QA System for developing and establishing new processes and vendors. d) System of structured documentation of Engg. and test records.	Manufacturer's work	5	1. Appreciation of implementation of QA programmes in various manufacturing, assembly and testing activities. 2. Appreciation of developmental activities for new processes and vendors. 3. System of prequalification of special processes.	Manufacturer's works where the equipment of the subject project is being manufactured.	3	1. operating feedbacks 2. Co-relation of reliability and performance of the equipment with implementation of QA system. 3. Appreciation of the use of structured Engg./ QA documentation during operational phase of plant and during RLA studies of plant.	Operating plants in any country includinh india where same make and similar capacity boilers are under operation.	1	18
5.2	Quality Assurance	SG & Auxiliaries	12 months	5	a) General Design, equipment, system and parameter famlarisation of supplied boiler	PMI	3							15
5.3	Quality Assurance	SG & Auxiliaries (Mechanical)	12 months	4	Pressure parts (Water wall panels, superheaters, Reheaters, headers, economiser, power cycle piping etc.) & Auxiliaries (Fans, Pulversier, APH, Soot blowers, Gates & Dampers, Feeder, SGWC pump etc.) Main design aspect including material of construction and applicable codes/ standards, manufacturing processes, machinery involved, various welding process involved, testing and inspection etc.	Manufacturer's work	3	1. Manufacturing, testing and inspection at various stages of Boiler Pressure parts and Auxiliaries 2. Shop level exposure to these processes with understanding of applicable code/ standard/ parameters involved in manufacturing of main pressure parts and auxiliaries. 3. Various testing and inspection activity in shop for above components.	Manufacturer's works where the equipment of the subject project is being manufactured.	4				28

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
5.4	Quality Assurance	SG & Auxiliaries: Control & instrumentation: Material, construction, Manufacturing, assembly, testing wrt QA aspects, quality procedure and QA system & I	12 months	1	1. Familiarisation with control system and instrumentation. 2. QA system for manufacturing of reliable components.	Manufacturer's work	2	1. Manufacturing activities for critical instruments/ items. 2. Implementation of testing programme to ensure reliability.	Manufacturer's works where the equipment of the subject project is being manufactured.	2	Feedback on performance of C&I system	Operating plants in any country includinh india where same make and similar capacity boilers are under operation.	1	5
QA TOTAL Mandays		66					39			24			3	66

SUMMARY

1.0	Steam Generator & Auxiliaries (Mechanical) TOTAL Mandays	173
2.0	Power Cycle Piping TOTAL Mandays	48
3.0	Electrical TOTAL Mandays	45
4.0	C&I TOTAL Mandays	148
5.0	QA TOTAL Mandays	66
GRAND TOTAL MANDAYS OF TRAINING FOR STEAM GENERATOR & AUXILIARIES		480
GRAND TOTAL MANMONTHS OF TRAINING FOR STEAM GENERATOR & AUXILIARIES		16.0

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
TURBINE GENERATOR AND ITS INTEGRAL AUXILIARIES	Turbine cycle optimization and turbine performance in off design condition. Rotor design and strength calculation Rotor dynamic behavior studies wrt natural frequency, critical speed, vibration etc. Blade profile/root design and blade strength design, blade vibration analysis Casing & diaphragm design Labyrinth seal selection & design for different turbine configurations Selection of turbine type (i.e. Tandem vs cross compounding, separate HP/IP vs combined HP/IP, material of construction etc.) Design principle for Up rating/down rating of existing design/ modules for the	Familiarization of power plants of various makes of turbines for super critical units Collection of data for analysis of availability of turbines Comparative studies for integral systems of turbine O&M history/problems related to turbine Failure analysis	Manufacturing processes of turbine Assembly of turbine Testing of turbines Product development in process Future plan for technology induction R&D work in progress	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII PAGE 92 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
	specific project. of bearings, load calculation on bearings, bearing oil flow calculation Selection, design and control principle for Turbine governing system Performance calculation Steam path audit Layout principle of various equipment's of TG and its integral system Latest technological advancements			
MANDAYS Boiler Feed Pumps	45 Techno-economic studies for Selection of BFP Configuration and its drive Criteria for selection of boiler Feed Pump parameters Rotor design, strength calculation and rotor dynamic behavior studies wrt critical speed, vibration etc	10 Familiarization of power plants of various makes of feed pumps for super critical units Data collection of BFP parameters and configuration Collection of data for analysis of availability of BFP	10 Manufacturing process of various components of BFP Assembly of BFP Testing, capabilities of BFP at works wrt performance, NPSH, dry run, visual cavitation, axial thrust measurement	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII	PAGE 93 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
	Impeller design and its hydraulic behavior Role of critical parameters such as NPSH(R), Suction specific speed, running clearances, speed etc. in design of feed pumps Material selection of BFP components Guiding factors for selection of BFP seals Computation of axial thrust under various flows Performance calculation Transient analysis in pump suction piping wrt NPSH margin Latest technological trends in BFP design	O&M history/problems related to BFP Comparative studies for various types of BFP& its features	Product development in process Future plan for technology induction R&D work in progress	
MANDAYS	20	5	10	
Condenser	Selection of condenser type and its optimization wrt temp rise across condenser, pressure drop in condenser, surface area etc.	Comparative studies of salient features	Manufacturing process of various components of condenser Assembly	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII	PAGE 94 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
	Techno economic studies for Selection of condenser tube material and other parts depending on water quality Condenser support selection & design Sizing of condenser w.r.t. super critical units Latest technological trends in condenser arrangement and design Condenser vacuum system design	Collection of data for analysis of availability of Condenser O&M history/problems related to condenser	Testing capability at works Product development in process Future plan for technology induction R&D work in progress	
MANDAYS	10	5	5	
Feed Regenerative Equipment's	Thermal and mechanical design calculation of heaters Basis of selecting horizontal/vertical heaters Selection of TTD and DCAs for various heaters, and their effect on turbine heat rate Configuration of HP heaters (2x50% v/s100% capacity) Sizing criteria for De-aerator/Heaters Selection of tube & tube sheet material of heaters	Comparative studies of salient features Analysis of data O&M history/problems related to heaters	Manufacturing process of various components of heaters Assembly Testing capability at works Product development in process Future plan for technology induction R&D work in progress	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII	PAGE 95 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
MANDAYS	Latest technological trends in heaters design 15	10	10	
3-dimensional CFD modeling	CFD model development and validation of design data for steam turbine, BFP, CEP, condenser, heaters etc.			
MANDAYS	20			
CONTROL & INSTRUMENTATION DDCMIS*-Man Machine Interface Hardware & Operating System	Hardware & Software organization of the system Basis of selection of H/W memory sizing Operating system features, interface with other system, openness & interoperability Upgradability System testing features Trouble shooting and fault analysis	Operational feedback		
MANDAYS	15	5		
DDCMIS*-Man Machine Interface System Engineering & Application Software	Specific system customization Various system modules & interface with OS Database organization & development	Operation feedback		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII	PAGE 96 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
	Development of mimics Other application like calculations, logs historical storage functionalities & use Trouble shooting and fault analysis			
MANDAYS	30	5		
DDCMIS* - Control System Hardware	Basic design features for system & its modules System capabilities & system design techniques Communication with MMI & other system	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities	
MANDAYS	15	3	10	
DDCMIS*- Control system Application Software	Database structure Organisation & interface between application program & database Application for implementation of Control functions Study of standard algorithms & development of new algorithms Trouble shooting and fault analysis	Operation feedback	System integration & System capabilities testing	
MANDAYS	8	2	4	
DDCMIS* - DDCMIS- Control Strategies for TG System:	P&ID and process/System Descriptions of Governing System, Protection System, Automatic Turbine Testing, Oil System, Evacuation System & Generator Auxiliaries, Turbine stress Computation	Yes	Yes	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII
				PAGE 97 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
Process Concepts of Main TG Integral Systems	System, Gland seals, Turbine Start up and Shut-down process, Hot ,cold and Warm modes of Turbine start up etc.			
DDCMIS* DDCMIS- Control Strategies for TG System: Control Strategies	- Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system. Function Blocks: Introduction and explanation of TG process specific Function block as being implemented in offered Control system. Open Loop Control strategies for ATRS, including turbine Run/Up Shutdown, Auto Synch, Oil System Automation concept, Auto Changer over philosophies, Condenser evacuation system, ATT and Generator Auxiliaries. Close Loop Control strategy-EHTC, Seal/Leak steam Controls, Interfacing of unit Controls Protection-Fail Safe philosophy implementation in turbine protection.	Yes	Yes	
DDCMIS- Control Strategies for TG System: Process Concepts of HP/LP BP Systems	P&ID and process/System Descriptions of HP/LP BP System, Protection System, Oil System, HPBP operations under various modes like start up, Shutdown, Load throw off etc.	Yes	Yes	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII
				PAGE 98 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
DDCMIS-Control Strategies for TG System: HP/LP BP Systems Control Strategies	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system. Function Blocks:- Introduction and explanation of HP/LP process specific Function block as being implemented in offered Control system. Open Loop Control strategies for HPBP operation during various modes of plant operation like Start Up/Shut down and Load Throw Off etc. Close Loop Control strategy- Applicable Control Loops like HP/LP BP Press Control/Position Control, LP BP Spray Controls etc. Interfacing o unit Controls etc. Protection-Fail Safe philosophy implementation in HP/LP BP system	Yes	Yes	
DDCMIS-Control Strategies for TG System: Process Concepts of BFP Drive Turbine/ BFP Systems	P&ID and process/System Descriptions of Drive Turbine Governing System, Protection System, Oil System, Turbine Start up and Shut-down process, Hot, cold and Warm modes of Turbine start up etc.	Yes	Yes	
DDCMIS-Control Strategies for TG System:	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system.	Yes	Yes	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII
				PAGE 99 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
BFP Drive Turbine/ BFP Systems Control Strategies	Function Blocks:- Introduction and explanation of BFP Drive Turbine process specific Function block as being implemented in offered Control system. Open Loop Control strategies for Drive Turbine Start UP/Shutdown, Oil System Automation concept, Auto Changer over philosophies. Close Loop Control strategy-EHTC, Seal/Leak steam Controls, Interfacing of unit Controls Protection-Fail Safe philosophy implementation in Drive turbine protection.			
MANDAYS	24	5	4	
DDCMIS-operator	Use of the system at work + at Site			
MANDAYS	4			
Turbo supervisory system : Measurement Concepts	Discussions on various measurement points, Types, Ranges and locations for the offered Turbine	Yes	Yes	
Turbo supervisory system : System Concepts	System implementation of sensors, Monitors, Drivers, Cabling, earthing shielding and grounding, Buffered signals, Technical aspects of sensor selection, Sensor specifications, filter setting, Configuration settings for displacement, Velocity ,acceleration, key phasor and other types of sensors. Diagnostics and	Yes	Yes	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII
				PAGE 100 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
	trouble shooting features of Sensors, Drivers and Monitors.			
Turbo supervisory system : Analysis Software	1)System Setup-Hardware and Software 2)Case Studies showing utilization of various data displays e.g Bode Plot, Polar Plot, Waterfall Plot, Orbit & Waterfall Plot etc. 3)Tools and methods of finding Machinery faults like oil whirl, Oil whip, Mis-alignment etc	Yes	Yes	
MANDAYS	8	2	2	
Wherever "DDCMIS" is indicated, it will mean TG C&I part of DDCMIS, which is in Contractor's Scope				
(ELECTRICAL) GENERATOR	(a) Design aspects of the following areas - Insulation system - Cooling medium & arrangement - Winding & core support systems b) Design aspects associated auxiliary systems	- Operational feed back - Familiarisation with different sub-systems	(a) Manufacturing process for - Core - Winding bars - Assembly (b) Testing facilities	
MANDAYS	30	15	15	
Generator Excitation system including AVR.	Design features of various sub- System Exciter PMG Transformer Controllers & different limiters etc.	- Operational feed back - Familiarisation with various equipment functioning at reference plants	Manufacturing process & testing facilities for various equipment of excitation system	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII	PAGE 101 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-VIII			
PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
	PSS & associated system studies	functioning at referplants		
MANDAYS	30	15	15	
Integral Actuators	a) Basic design philosophy of integral actuator b) Design aspects of wiring diagram c) Type and range of application of integral actuators d) Operation and selection of integral actuator to various type of loads Methods of fault diagnose system.		Manufacturing process & testing facilities for various equipment of actuators	
MANDAYS	2	1	1	
MDBFP motor	Design criteria for the stator core and winding rotor core and winding, insulation systems and cooling arrangement. Study of forces and vibration. Diagnostic and testing of large Electrical machines	Operational Feedback	Manufacturing process and testing facilities.	
MANDAYS	14	4	10	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII	PAGE 102 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE-IX			
	Area	Topics	MANDAYS	
	DDCMIS-Man Machine Interface - Hardware & Operating System	- Hardware & Software organization of the system - Basis of selection of H/W memory sizing - Operating system features, interface with other system, openness & inter-operability - Upgradeability - System testing features	20	
		Trouble shooting and fault analysis.		
	DDCMIS-Man Machine Interface System Engineering & Application Software	- Specific system customisation - Various system modules & interface with OS - Database organisation & development - Development of mimics - Other application like calculations, logs historical storage functionalities & use - Trouble shooting and fault analysis.	40	
	DDCMIS - Control System Hardware and Control system Application Software	- Basic design features for system & its modules - Manufacturing processes with special attention to handling of the modules Maintenance facilities	50	
		- System capabilities & system design techniques - System integration & System capabilities testing		
		Communication with MMI & other system		
		Database structure Organisation & inter- face between application program & database		
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-IX

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
		• Application for implementation of Control functions • Study of standard algorithms & development of new algorithms	
		• Trouble shooting and fault analysis.	
	DDCMIS-Operator Training	• Use of the system at Works + at Site	20 + 100
	DDCMIS-Specialized Network security training	• To be finalized during detailed engineering.	15
	UPS system	• Theory & design features Manufacturing/assembly process • Testing methodology	5
		• Trouble shooting and fault analysis.	
	24 V DC system	• Theory & design features Manufacturing/assembly process • Testing methodology • Trouble shooting and fault analysis.	5
	SWAS	• Theory & design features • Trouble shooting and fault analysis	5
	PA System	• Theory & design features • Trouble shooting and fault analysis	4
	CCTV System	• Theory & design features • Trouble shooting and fault analysis	4
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-IX PAGE 104 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	QA SYSTEM & PROGRAMME	- Integrated QA Management system for enhanced reliability of equipments. - QA system in design, procurement, manufacturing, installation and operation of the equipments/ systems. - QA system for developing and establishing new processes and vendors. - System of structured documentation of Engg and test records. - Appreciation of implementation of QA Programme in various manufacturing, assembly and testing activities. - Appreciation of develop-mental activities for new processes and vendors. - System of pre-qualification of special processes.	10	
	Controls & Instruments	- Familiarization with control system and instrumentation - QA System for manufacture of reliable components. Manufacturing activities for critical instruments/items. - Implementation of testing programme to ensure reliability.	10	
	Note	One week shall constitute of five (5) man days.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-IX	PAGE 105 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	ANNEXURE-X			
PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
GIS			Training on GIS equipments including system description basic design and engineering. Quality assurance concepts and Erection and operational aspects for the offered equipments. Concepts and operational aspects for the offered equipments	Training on Operation, Maintenance,, site testing & troubleshooting of GIS.
MANDAYS			40	30
Substation Automation System				Training for site personnel for operation, maintenance & troubleshooting of total system for 5 working days at NTPC site.
MV and LT Switchgear : Numerical relays & Switchgear SCADA system	Numerical relay engineering and associated training for relay software and O&M SCADA system design, engineering and associated training for SCADA and O&M			
MANDAYS	60 (Total) inclusive of visit to manufacturer's site)			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-C BID DOC. NO.: CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS ANNEXURE-X
				PAGE 106 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC						
	ANNEXURE - XI									
	<table><tr><th>Area</th><th>Topics</th><th>MANDAYS</th></tr><tr><td>UF Membranes</td><td> Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ultrafiltration membranes and design Plant Visit - Operational feedback - O&M history/problems related to UF membranes Visit to Manufacturer's Work - Manufacturing process of UF membranes and equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization </td><td>7</td></tr></table>	Area	Topics	MANDAYS	UF Membranes	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ultrafiltration membranes and design Plant Visit - Operational feedback - O&M history/problems related to UF membranes Visit to Manufacturer's Work - Manufacturing process of UF membranes and equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	7			
Area	Topics	MANDAYS								
UF Membranes	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ultrafiltration membranes and design Plant Visit - Operational feedback - O&M history/problems related to UF membranes Visit to Manufacturer's Work - Manufacturing process of UF membranes and equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	7								
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-XI	PAGE 107 OF 111						

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	RO membranes	Product design - Basic design features - Theory & principle of operation - Latest technological trends in RO membranes and design Plant Visit - Operational feedback - O&M history/problems related to RO membranes Visit to Manufacturer's Work - Manufacturing process of RO membranes and equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	7	
	Zero Liquid Discharge (ZLD)	System Design - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant Plant Visit - Operational feedback	5	
	Note	One week shall constitute of five (5) man days.		

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-XI	PAGE 108 OF 111
---	--	--	--------------------

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC									
	Annexure-XII TRAINING REQUIREMENTS FOR SIMULATOR In addition to the other stipulations in the bidding documents regarding training of Employer's personnel, the following shall also be covered: (i) The scope of service under training of Employer's Engineers shall necessarily include, training in the areas of: (a) Design, engineering and Quality Assurance. (b) Operation & maintenance. Arrangement for the trainees to get trained at the Works of the Contractor's, Works of their sub-vendors and at the plants of similar type and comparable size, operating elsewhere shall be made by the Contractor. (ii) The training shall enable the O&M personnel to individually take responsibility of operating & maintaining the respective systems to ensure sustained guaranteed performance of the equipment and availability of the systems offered. The design & engineering personnel of the Employer shall be familiarized with the design philosophy adopted & practices followed by the Contractor or Sub-Contractor's Engineers for design engineering and shall be given special training in the shops, where the equipment will be manufactured and/or in their collaborator's works and where possible, in any other plant where equipment manufactured by the Contractor or his collaborator is under installation operation, or testing to enable these personnel to become familiar with the equipment being furnished by the Contractor. The training requirements of Employer's Engineering and O&M personnel are as below: <table><tr><th>Area</th><th>Topics</th><th>MANDAYS</th></tr><tr><td rowspan="4">Simulator & Human Machine Interface – Hardware and Operating System</td><td> • Hardware & software organization of the system </td><td rowspan="4">90</td></tr><tr><td> • Basis of selection of HW memory sizing </td></tr><tr><td> • Operating system features, interface with other system, openness & inter operability & upgradability System Testing features </td></tr><tr><td> • Trouble shooting & Fault Analysis </td></tr></table>				Area	Topics	MANDAYS	Simulator & Human Machine Interface – Hardware and Operating System	• Hardware & software organization of the system	90	• Basis of selection of HW memory sizing	• Operating system features, interface with other system, openness & inter operability & upgradability System Testing features	• Trouble shooting & Fault Analysis
Area	Topics	MANDAYS											
Simulator & Human Machine Interface – Hardware and Operating System	• Hardware & software organization of the system	90											
	• Basis of selection of HW memory sizing												
	• Operating system features, interface with other system, openness & inter operability & upgradability System Testing features												
	• Trouble shooting & Fault Analysis												
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-XII	PAGE 109 OF 111									

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Simulator System Engineering (Simulator Kernel and Interface) & Application Software (Process and C&I Modelling)	• Overview of Simulator • Starting up and Shutting down of the simulator • Details of Simulator hardware & software • Interaction between Simulator Models and controls & Instructor Station operations • Manipulation of Simulator parameters and data.	150	
		• Details of Plant Modelling & C&I Modelling simulation software		
		• Details of Simulator and DCS interface		
		• Backup and Restore procedures		
		• Details of I/O system		
		• Fault finding of simulator hardware & Software diagnostic procedures		
		• Simulator maintenance procedures		
	Human Machine Interface System Engineering & Application Software	• Specific system customisation	90	
		• Various system modules & interface with OS		
		• Database organisation & development • Development of mimics • Other application like calculations, logs historical storage functionalities & use		
		• Trouble shooting and fault analysis.		
	Instructor Training	Use of the system including • Interaction between Simulator Models and controls • Instructor Station operations	150	
		• Communication with MMI & other system		
• Database structure Organisation & inter-face between application program & database				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-XII	PAGE 110 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		• Application for implementation of Control functions • Study of standard algorithms & development of new algorithms		
		• Trouble shooting and fault analysis.		
	UPS system	• Theory & design features manufacturing/assembly process • Testing methodology		10
		• Trouble shooting and fault analysis.		
	Note	Note One week shall constitute of five (5) man days.		

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-XII	PAGE 111 OF 111
---	--	---	--------------------

3X800MW PATRATU STPS

SECTION I-A QUALITY ASSURANCE



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

CLAUSE NO.	QUALITY ASSURANCE			
1.00.00	<u>AIR COMPRESSOR SYSTEM</u>			
1.01.00	AIR COMPRESSORS : a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes. b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes. c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia. >= 40mm). MPI/DP test will be done on machined areas of the above components. e) During assembly all clearances and alignments shall also be checked and recorded. f) Rotor shall be statically and dynamically balanced.			
1.01.01	PERFORMANCE TEST (SHOP TEST) : a) Performance test on the compressors shall be carried out in accordance relevant standard. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves. b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured. c) Vibration and noise level measurement will be done during shop performance test. d) Test shall be carried out on all compressors with contract drive motor where power consumption for compressors has been indicated as a guaranteed parameter e) Clearance on Type test requirements from Employer's Engg. Shall be reviewed prior to final clearance.			
1.02.00	AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT: a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes. b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below: (i) 100 % DPT on root run of butt welds. (ii) 100% DPT on all finished butt welds and fillet welds (iii) 10% RT on butt welds which shall include all T- joints. c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards. d) Reactivation blowers shall be tested for FAD, temp. rise, noise & vibration. Rotating parts shall be dynamically balanced.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2	SUB-SECTION-E-22 COMPRESSED AIR SYSTEM	Page 1 of 2

CLAUSE NO.	QUALITY ASSURANCE 		
1.04.00 1.05.00	e) Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done. H.O.T. CRANE : a) Chain pulley Blocks shall be tested as per IS: 3832. b) Following NDT requirements shall be met : (i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression. (ii) DP at random on all weldments. Deflection, load, overload & travel check on HOT crane assembly shall be carried out as per IS:3177. PIPINGS, VALVES, AND FITTINGS For Pipes, Valves, and Fittings refer LP Piping System requirements.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2	SUB-SECTION-E-22 COMPRESSED AIR SYSTEM	Page 2 of 2

3 X 800MW PATRATU STPS

ANNEXURE - I

(SUB- VENDOR LIST)

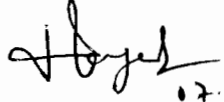


BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA



**COMPRESSED AIR SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS**

LIST OF MAKES OF SUB-VENDOR ITEMS


07.07.15
(Harish Kumar)
PEM-MACX



SUB VENDOR LIST & INSPECTION CATEGORISATION (ANNEXURE-II)

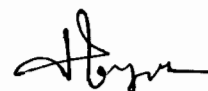
COMPRESSED AIR SYSTEM

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
1	AIR DRYING PLANT (HOC TYPE)	I	ACIL	BELGIUM	ROTARY DRUM	Testing at Atlas Copco Works Pune
			MELLCON	Delhi	Twin Tower type	
			DELAIR	Gurgaon	Twin Tower type	
			SUMMITS	Coimbtore	Twin Tower type	
			Shalcot	Noida	Twin Tower type	
2	AIR DRYING PLANT (REFRIGERANT TYPE)	I	ACIL	BELGIUM		
			MELLCON	Delhi		
			DELAIR	Gurgaon		
			SUMMITS	Coimbtore		
			Shalcot	Noida		
			Savroe	Germany		
			MTA	Italy		
			Dominic Hunter	U.K		
3	MS/GI Pipes –ERW IS 1239 / IS 3589	III	SAIL	Rourkela		1) Quantity < 200 meters Assorted sizes)
			Jindal	Ghaziabad/Hissar	upto 350NB	2) Material will be accepted on the basis of Main contractor COC supported by manufacturer TC as per relevant Code. In addition to above main contractor will certify availability of correlated identification marks on pipe wrt Manf TC and will also certify that pipes are free from rust
			Surya Roshni	Bahadurgarh	upto 400 NB	
			Tata IS 1239 Pipes	Jamshedpur	upto 150NB	
			Maharashtra seamless IS 3589	Raigad	200 to 500 NB	
			PSL	Chennai/Vizag/Kutch/Daman	Spiral Weld SAW as per IS 3589	
			Lalit Profile	Thane	Spiral Weld SAW as per IS 3589	
			Samshi Pipes Industries	Vadodara	Spiral Weld SAW as per IS 3589	
			Mukut Pipes	Rajpura	Longitudinal SAW (Single side weld) as per IS 3589	
			Indus Tubes	G B Nagar	Upto 300 NB ERW Pipes as per IS 1239/3589	
			Mann Ind	Indore	Spiral Weld SAW as per IS 3589	
			Surendra Engg	Rajpura	Spiral Weld SAW as per IS 3589	

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			Pratibha Pipes & Structure Pvt Ltd	Thane	Spiral Weld SAW as per IS 3589	
			JCO Gas Pipe	Chindwara	Spiral Weld SAW as per IS 3589	
			Nukat Tanks and Vessels	Tarapur	Longitudinal SAW (Single side weld) as per IS 3589	
			DADU Pipes	Sikandrabad	Upto 300 NB ERW Pipes as per IS 1239/3589	
			Good Luck Tubes	Sikandrabad	Upto 300 NB	
			Advance Steel Tubes	Sahibabad	Upto 300 NB	
			APL APPOLO Tubes	Sikandrabad	Upto 300 NB	
			Hi Tech Pipes	Sikandrabad	Upto 300 NB	
			Ratnamani	Kutch/Ahmedabad/Chhatral	Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589	
			Welspun	Anjar/Bharuch	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589	
4	Forged/Formed fittings	III	EBY	Taloja		
			Siddarth & Gautam	Faridabad		
			Pipefit	Baroda		
			MS Fittings	Kolkata		
			Tube Products	Baroda		
			Bharat Forge	Pune		
			NL Hazra	Kolkata		
5	Ball Valve	I	Precision Engg	Nasik	upto 400NB 150 class	
			Microfinish Valves Ltd	Hubli		
			Weir BDK engg Industries	NEW DELHI		
			Flow chem. Industries	Ahemdabad	upto 50 NB 800 Class: 350NB 150 class	
			Audco	Chennai		
			Akay India	Hubli	upto 50NB 800 class	
			A V Valves	Agra		
			Asian Industrial valves & Instruments Ltd.	Chennai		
			ATAM Valves	Jalandhar	(1) BALL VALVES: FCS/FSS - 1/2" to 2" #800 & CCS/CSS - 2.1/2" to 4" # 150 (2) BALL VALVES: CUN METAL VALVES SIZE 15 NB TO 80 NB - UPTO PN16.0	
			GM ENGINEERING	Rajkot		
			Hawa Valves (India) Pvt. Ltd.	Navi Mumbai	Size up to 2" & #800 with MOC as FCS & FSS and for size from 65 NB to 150 NB & #150 with MOC as CCS and CSS.	


 07.07.15
 (Harish Kumar)

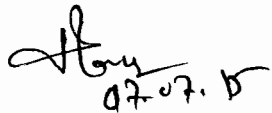
SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			INTERVALVE (INDIA) LTD.	Pune	Steel ball Valves upto 50NB, #800 and 65NB to 150NB. #150	
			NILON VALVES PRIVATE LIMITED	Ahmedabad		
			LEADER VALVES LTD.	Jalandhar	CAST STEEL UPTO 200 MM, CLASS 150/300.	
			DEMBLA VALVES LTD.	Thane		
			SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR CARBON STEEL/STAINLESS STEEL UPTO SIZE 200NB.	
			UNIFLOW	Chennai		
			VALTECH INDUSTRIES	Mumbai	FORGED CARBON & ALLOY STEEL BALL VALVES, SCREWED TYPE BALL VALVES RATING 800, SIZES UPTO 50 & CC& ALLOY STEEL BALL VALVES RATING 150, SIZES 65 TO 200 FLANGED TYPE.	
			VAAS AUTOMATION	NEW DELHI		
			Belgaum Aqua Valve	Belgaum		
6	CS/FS Gate/Globe/Check valves	III	Fouress	Mumbai/ Aurangabad		
			Weir BDK	NEW DELHI		
			L & T Valves	Coimbatore/ Kancheepuram		
			Leader	Jalandhar		
			KSB	Coimbatore		
			A V Valves	Agra		
			ATAM Valves	Jalandhar	(1) Carbon Steel Gate Valves & non return valves: 15 NB to 50 NB (#800) & 65 NB to 300 NB (#150) (2) Carbon Steel Globe Valves: 15 NB to 50 NB (#800) & 65 NB to 200 NB (#150)	
			Fluidline valves	Ghaziabad		
			GM ENGINEERING	Rajkot		
			INTERVALVE (INDIA) LTD.	Pune	a) Steel Gate Valves: upto 50NB, #800 and 65NB to 150NB, #150 b) Steel Globe Valves: upto 50NB, #800 and 65NB to 100NB, #150 c) Supplier not registered for NR Valves	
			Niton Valves	Mumbai		
			NSSL Ltd.	Nagpur		
			Steel Strong valves Ltd.	Navi Mumbai		


 07.07.15
 (Harish Kumar)

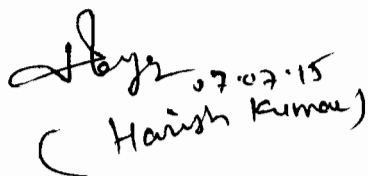
SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			VENUS PUMPS AND ENGG. WORKS	Kolkata	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500, GLV-BBT- UPTO300NB CL UPTO600, SCNRV- BBT-UPTO600NB CL UPTO150, SCNRV-BBT- UPTO300NB CL 300, SCNRV-PSBT- UPTO150NB CL UPTO900	
			VALTECH INDUSTRIES	Mumbai	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900, GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300, GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.	
			V K Valves Ltd.	Jalandhar		
			KBL	Kondhapuri		
7	Butterfly Valve	II	KBL	Kondhapuri		
			Fouress	Bangalore		
			Audco	Chennai		
			Weir BDK	NEW DELHI		
			Tyco	Halol		
			Inter Valve	Pune		
			Advance Valves	Noida		
			Fluidline valves	Ghaziabad		
			Instrumentation Ltd.	Palakkad		
			R and D Multiples (Metal Cast) Pvt. Ltd.	Mumbai		
			SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR CI , CCS & CSS UPTO SIZE 750 NB.	
			PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	Navi Mumbai		
			UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	Kolkata	MOC-Cast Iron, size from 65 NB to 350 NB having rating of PN10 as per BS EN 593.	
			VENUS PUMPS AND ENGG. WORKS	Kolkata		

Handwritten signature
07.07.15
(Harish Kumar)

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
8	Air Receiver	I	Integrated Engineers	Mumbai		
			Diamond Fabricators	Pune		
			Parkaire	Delhi		
			Temasme Vesselex	Noida		
			United Engineering Works	Nasik		
9	Safety Relief Valve	III	LEADER	JALANDHAR		
			SPIRAX MARSHALL	PUNE		
			FISCHER SANMAR	CHENNAI		
10	Pr./Vacuum/Dp Gauges	III	Auxitrol	U.K		
			Switzer (for DP gauge)	Chennai		
			Budenburg	U.K		
			A.N.Instruments	Kolkata		
			Bells Control	Kolkata		
			Manometer India	Mumbai		
			H Guru Industries	Kolkata		
			Ashcroft India	Kalol		
			General Inst.	Mumbai/Goa		
			Gluck India	Mumbai		
			BOSE PANDA INSTRUMENTS PVT.LTD.	Kolkata		
			Forbs Marshall	Hyderabad		
			Gauge Bourdon	Mumbai		
			H Guru Instruments	Bangalore		
			Baumer Technologies	Mumbai		
11	Pr./Vacuum/DP.switch	III	Barton Inst.system	USA		* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
			Indfoss	Ghaziabad		
			SOR	USA		
			Dressor	USA		
			Delta control	UK		
			Trafag	Ranipet		
			GiC(Gauges Bourdon)	Panvel		
			ASHCROFT INDIA PVT LTD.	USA/GERMANY		
			Switzer	Chennai		
12	Temperature Gauge	III	Budenburg	U.K		
			A.N.Instruments	Kolkata		
			Bells Control	Kolkata		
			H Guru Industries	Kolkata		
			General Inst.	Mumbai/Goa		
			H Guru Instruments	Bangalore		
			Forbs Marshall	Hyderabad		
			Goa Instruments	Goa		
			Goa Thermostatics Instruments Pvt. Ltd.	Goa		
			Gauge Bourdon	Mumbai		
			Baumer Technologies	Mumbai		


 07.07.18
 (Harish Kumar) 28/06/2018

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			Ashcroft India	Kalol		
13	Transmitters (PT, TT, DPT, LT)	II	ABB	Faridabad	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER	* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
			Yokogawa	Bangalore		
			Emerson	Mumbai		
			(ABB) -2600T series	Faridabad/Italy		
			Pune Techrol Pvt. Ltd.	Pune	Only for capacitance Type Level Transmitter	
			SIEMENS LIMITED	Mumbai		
			SMART INSTRUMENTS LTD, BRAZIL	Mumbai	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.	
			SBEM PVT. LTD.	Pune	Only for capacitance Type Level Transmitter	
			TOSHNIWAL INDUSTRIES PVT. LTD.,	Ajmer		
			V. AUTOMAT & INSTRUMENTS (P) LTD.	NEW DELHI	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS	
			Honeywell Automation	NEW DELHI		
			Fuji	Japan		
			NIVO CONTROLS PVT. LTD.	Indore	For Capacitance type only	
			Moore Industries International Inc.	CALIFORNIA, USA	Indian Associate - Chemtrol	
			Endress + Hauser (India) Pvt. Ltd.,	NEW DELHI	TEMP TRANSMITTER ONLY	
14	HT Motor for Air compressor	I	CGL	Mandideep	Upto 1600 KW, 6.6 KV; Upto 1310 KW, 11 KV	
			Marathon Electric	Kolkata	Upto 6.6 KV, 750 KW	
			BHEL	Bhopal		
			SIEMENS	Germany		
			Hyosung	Korea		
			Hyundai	Korea		
15	Flow Switch	III	Switzer	Chennai		
			Levecon	Kolkata		
			DK Instruments	Kolkata		
			Delta	UK		
			ITT Barton	USA		
16	Temp Sensor	III	Pyro Electric	Mumbai		
			Detriv	Mumbai		
17	Flow Indicator	III	Sigma	Mumbai		
			Eureca	Pune		
18	Auto Drain Trap	III	Pennant	Pune		
			Forbes Marshall	Pune		
19	Dew point meter	III	GE Sensing	Ireland		



 07.07.15

 (Harish Kumar)

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
20	Flow Meter / Rota Meter	III	Michelli Instruments	UK		
			XENTAUR	USA		
			Shaw	UK		
			Trac	Hyderabad		
			Eureca	Pune	Rota Meter only	
			Flow Star Engg.	Faridabad	Rota Meter only	
			Flow Tech instruments	Vadodara	Rota Meter only	
			Instruments Engineers Pvt. Ltd.	Hyderabad	Rota Meter only	
			Scientific Devices (Bombay) Pvt. Ltd.	Mumbai	Rota Meter only	
			Emerson Process Management	singapore	Vortex Type	
			ABB Ltd.	India	Vortex Type	
			Krohne Marshall Pvt. Ltd.	India	Vortex Type	
			Endress + Hauser (I) Pvt. Ltd.	India	Vortex Type	
			Yokogawa Electric Corporation (other than high temp & h2 services)	japan	Vortex Type	
			Krohne Messtechnik GmbH & Co. Kg	Germany	Vortex Type	
21	Level Indicator/ Gauge	III	Flow Star	Faridabad		
			Scientific Devices	Mumbai		
			Gauges Bourden	Panvel		
			SBEM	Pune		
			Pune Techtrol	Pune		
			Levcon	Kolkata		
			Sigma	Mumbai		
			V-Automat	New Delhi		
			DK Instruments	Kolkata		
22	Solenoid Valve	III	HERION	GERMANY/ ITALY		
			ROTEX AUTOMATION LTD.	V V NAGAR/ BARODA		
			ASCO	CHENNAI		
			JEFFERSON	ARGENTINA		
			AVCON	MUMBAI		
23	Cable trays (max 300 meters)	III	INAR PROFILE	ANNAKAPALLI		
			ANAND UDYOG	THANE		
			MJ ENGG.	DELHI		
			INDIANA	MUMBAI		Galvanizing. At Karmatara
			TECHNO ENGG	CHANDIGARH		
			JAMUNA METAL	DELHI		


 7/7/15 -
 Harish Kumar

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
			INDUSTRIAL PERFORATION	KOLKATA		Galvanizing at Unistar
			VATCO	MUMBAI		Galvanizing At Sigma Mumbai
24	Cable Glands	III	SUNIL & COMPANY	KOLKATA		
			ARUP ENGG	KOLKATA		
			COMMET	MUMBAI		
			QUALITY PRECISION	KOLKATA		
25	Cable Lugs	III	DOWELLS	MUMBAI		
			CHETNA ENGG	NASIK		
			3D	VALSAD		
26	DC LEAD ACID/NI-CD BATTERY	III	AMCO SAFT INDIA LTD	BANGALORE	Ni-Cd batteries only	
			EXIDE INDUSTRIES LTD	NEW DELHI	Lead Acid batteries only.	
			HBL POWER SYSTEMS LTD	Hyderabad	NiCd and TUBULAR TYPE for Lead acid	
			HOPPECKE BATTERIEN GMBH & CO.KG,	Germany		
27	DC Battery Charger (for PLC Panel)	III	AMARA RAJA POWER SYSTEMS LIMITED	Tirupati		
			CHHABI ELECTRICALS PVT.LTD.	Jalgaon		
			CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	Kolkata		
			DUBAS ENGG PVT LTD	BANGALORE		
			HBL POWER SYSTEMS LTD	Hyderabad		
			JEMA ENERGY	Spain	For Static SCR Type Full Wave fully Control type	
			MASS-TECH CONTROLS PVT.LTD.	Mumbai		
			STATCON POWER CONTROLS LTD	Noida		
28	INSTRUMENT FITTINGS	III	AURA INCORPORATED	NEW DELHI		
			Astec Valves & Fittings Pvt. Ltd.,	Mumbai		
			Arya Crafts & Engineering Pvt. Ltd.	Mumbai		
			Comfit & Valve Pvt. Ltd.	Nandasan-Gujarat		
			FLUIDFIT ENGINEERS PVT. LTD.	Mumbai		
			Fluid Controls Pvt. Ltd.	Mumbai		
			HP VALVES & FITTINGS INDIA PVT. LTD.	Chennai		
			PRECISION ENGINEERING INDUSTRIES	Mumbai		
			Panam Engineers,	Mumbai		
			Perfect Instrumentation Control (India) Pvt. Ltd.	Mumbai		
			VIKAS INDUSTRIAL PRODUCTS	Noida		
29	SS Pipes	III	REMI	Mumbai		
			Ratmani	Ahmedabad		
			Apex Tubes	Behror		
			Choksi	Ahmedabad		
30	UPS	III	HITACHI-HIREL	Gandhinagar		
			APC	Bangalore		
			Delta	Gurgaon		
			Emerson	Mumbai		
			DB Power	Pune		
			Aplab	Mumbai		

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Technical Limit	Remarks
31	OWS/PC	III	HP/Compaq /Dell/HCL/IBM/Lenovo			
32	Printer	III	HP/Cannon/Epson/Xerox/IBM /Lexmark			
33	PLC Based Panels	I	SIEMENS	Nasik		
			SCHNEIDER	Nasik		
			ROCKWELL	Sahibabad		
			GE Intelligent Platform	BANGALORE		
			Honeywell Automation India Limited ,	Pune		
			ABB	Bangalore		
34	Fibre Optic Cable	III	Birla Ericsson	Rewa		
			Finolex	Pune/Goa		
			Aksh Fibre	Bhiwadi		
35	Junction Box	III	AJMERA INDUSTRIAL & FLEXPRO ELECTRICALS	Mumbai	For galvanised & FRP Junction	
			K.S.INSTRUMENTS	Navsari, Gujarat	Metal type Junction boxes only	
			SUCHITRA INDUSTRIES	Bangalore		
			Shrenik & Company,	Bangalore		
				Ahemdabad		
36	PAINTS	III	Asian Paints (I) Ltd.	Mumbai		
			Berger Paints India Ltd	Delhi		
			Goodlass Nerolac	Mumbai		
			Jenson & Nicholson (I) Ltd	Gurgaon		
			CDC carboline (I) Ltd.	Delhi		
			Shalimar Paints Ltd.	Gurgaon		
			Addison Paints Ltd	Chennai		
			Grand Polycoat	Mumbai		
			Bombay Paints	Mumbai		
			Jotun Paints	Pune		
			Hemple Paints	Singapore		

NOTES:-

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.
2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/ CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.


 7/7/15
 (Harish Kumar)

Vendor to refer to this list for items in their scope only(as indicated in Electrical scope sheet between BHEL & Vendor)

		PROJECT :PATRATU STPS (3X800 MW). PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2					LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL		REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017	
Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
1)	L T (415 V) Motors	Refer Note 1				ABB	FARIDABAD	A		UPTO 55KW
						ABB	BANGALORE	A		55KW – 200KW
						BHARAT BIJLEE	MUMBAI	A		RQP, FOR FLAME PROOF ALSO
						CGL	AHMEDNAGAR	A		FOR FLAME PROOF ALSO
						JYOTI	BARODA	A		
						KEC	BANGALORE	A		FOR FLAMEVPROOF ALSO
						KEC	HUBLI	A		UPTO 90KW; FOR FLAME PROOF ALSO
						LHP	SOLAPUR	A		UPTO 200KW
						MARATHON	KOLKATA	A		FOR FLAME PROOF ALSO
						NGEF	BANGALORE	A		UPTO 15KW
						SIEMENS	MUMBAI	A		
2)	HT MOTOR					BHEL	BHOPAL	A		

169

		PROJECT :PATRATU STPS (3X800 MW) PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017	
		Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS

NOTE 1 : FOR LT MOTORS

a) Less than 30 KW

Acceptance of Motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows:
 It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing /data sheets.

b) 30 KW -50KW

Acceptance of Motor rating between 30 KW & 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along with COC of the manufacturer & the contractor confirming as follows:
 It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing /data sheets.

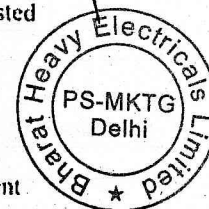
c) Above 50 KW as per NTPC approved quality plan

Approval Conditions attached to above vendors-as applicable shall prevail.

General Notes:

- 1) Vendor list & category of the mandatory spares shall be as mentioned above.
- 2) For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
- 3) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

[Signature] NTPC

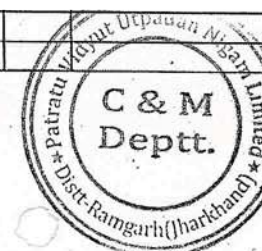
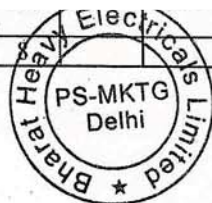


28/06/2018

Vendor to refer to this list for items in their scope only(as indicated in Electrical scope sheet between BHEL & Vendor)

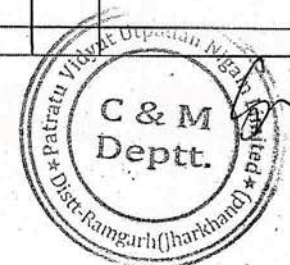
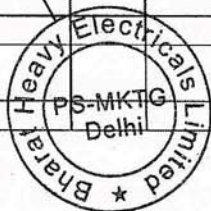
		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017		
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS	

10.	GI cable trays, fitting	I				Inar Profiles Ltd	Enkapalli	A		
-----	-------------------------	---	--	--	--	-------------------	-----------	---	--	--



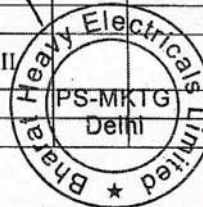
		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017	
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS

& accessories including bends						Vatco	Mumbai	A		Galvanization at Sigma Mumbai
						Indiana cable trays	Mumbai	A		Galvanization at Karamtara galvaniser
						Industrial Perforation	Kolkata	A		
						Ratan Engineering	Kolkata	A		Galvanization at B.P. Projects
						India Electric Syndicate	Kolkata	A		Galvanization at BMW Industries/B.P Projects
						Steelite engg.	Mumbai	A		
						Premier Power Products	Kolkata	A		Galvanising at Neha Galvaniser
						Indiana Gratings	Pune	A		Galvanization at Poona Galvanizer/ Anand Yeknow Aids Engg
						M.J. Engineering	Okhla/ Bhiwadi	A		
						Jamna Metal	Delhi/ Kundli	A		
						T.R.G	Chennai	A		Galvanization at TM Radhakrishna Chetty & Co
						Amtech	Pune	A		Galvanization at B.G. Shirke - Pune
						Kannade Anand Udyog	Mumbai	A		Fabrication at their units: Plot No. 42, District Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane.
						Rukmani	Raipur	A		Ladder type cable trays only
						Passive Infra	Hasangarh (Rohtak)	A		
						Unitech Fabricators &	Howrah/	A		



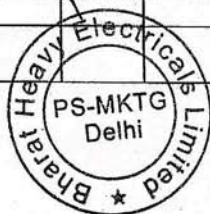
		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017	
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS

						Engineers	Hoogly (Kolkata)			
						Patny System	Hyderabad	A		Galvanisation at Gurpreet galvaniser - Hyderabad
						Rabi Engg	Kolkata	A		Galvanizing from NTPC approved sources
						Advance Power Products	Howrah	A		
						Maheswari Electricals	Noida	DR		
						Saral Industries	Raibareli	DR		
						Parmar Metal	Rajkot	DR		
						Pentax	Mumbai	DR		
						Eros metal	Nagpur	DR		
						Vinfab	Thane	DR		
						Namdhari	Ludhiana	DR		
						Indmark Formtech	PUNE	DR		
11.	Cable tray flexible support system (GI)	I	9			Vatco	Mumbai	A		Galvanising at Sigma Mumbai
						Inar profiles	Enkapalli	A		
						Industrial perforations	Kolkata	A		
						Premier power products	Kolkata	A		Galvanising at Neha Galvaniser
						Steelite engg.	Mumbai	A		
						Indiana gratings	Pune	A		Galvanising at Poona Galvaniser
						Amtech	Pune	A		Galvanising at B.G. Shirke
						Ratan Projects	Kolkata	A		Galvanization at NTPC approved sources
12.	Lead coated steel flexible conduits	III				Indmark Formtech	PUNE	DR		
						M/s PLICA	Ghaziabad	A		
						M/s Lapp	Germany	DR		
						M/s Bansal Labs	Bhopal	A		



		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017	
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS
13.	Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III				Main contractor approved sources with galvanization from NTPC approved sources (Note-2)		Noted		
14.	FRP Junction boxes	II	10			Main Contractor approved sources		Noted		

16.	Cable glands	III				Main contractor approved sources		Noted		
17.	Cable lugs	III				M/s Dowell M/s Billets Elektro Werke Ltd.	Mumbai Umbergaon	A A		



		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017		
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS	
						(3 D) M/s Chetna	Nasik	A			
						Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no. Refer Note-3		Noted			

197

Linek

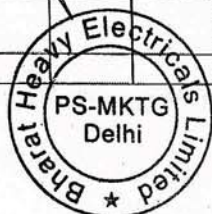


2

		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017		
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLI ER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS	

26.	PVC conduit/hume pipe/lighting wire/GI pipes/HDPE pipe/Structural Steel	III			BIS licensee / ISI marked with valid CML number	A		
27.	GI steel rigid conduit/ epoxy conduit	III			BIS licensee with valid CML number	A		

Link



John

		PROJECT : Patratu STPP (2X660 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017		
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS	

NB:

Under Sub Supplier approval status as per NTPC column:

A: mean that vendor for this item is acceptable to NTPC.

Under QP / INSPN CATEGORY column:

CAT-I : For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection & witness by NTPC

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of verification of documents as per approved QP

CAT-III : For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.

@ : Vendors acceptance is subject to sub-QR clearance.

Note-1- Approval conditions attached to above identified vendors, as applicable shall be adhered to.

Note-2 – List of NTPC acceptable galvanizers

[Handwritten signature]



[Handwritten signature]

		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017																					
		<table border="1"> <thead> <tr> <th>Sl. No.</th> <th>ITEM</th> <th>QP / INS CAT</th> <th>QP No:- 9578-001-QVE-</th> <th>QP SUB. SCH.</th> <th>QP APP L SCH EDU LE</th> <th>SUB-SUPPLIERS</th> <th>PLACE</th> <th>SUB-SUPPLIER APPL STATUS AS PER NTPC</th> <th>SC AP PL SC HE DU LE</th> <th>REMARKS</th> </tr> </thead> <tbody> <tr> <td colspan="2"> 1. M/s M J Engg, Delhi 2. M/s Jamna Metal, Delhi 3. M/s A.V. Engg, Kolkata 4. M/s Inar Profiles, Vishakapatnam 5. M/s Anand Udyog, Mumbai 6. M/s Techno Engg, Chandigarh 7. M/S Steelite Engg, Mumbai </td> <td colspan="2"></td> <td colspan="2"> 8. M/s National Galvanizer, Kolkata 9. M/s Unistar Galvanizer, Kolkata 10. M/s B.P. Project. Kolkata 11. M/s Bajaj Pune 12. M/s Electrocure Industries, Mumbai 13. M/s B.G. Shirke, Pune 14. M/s Gurpreet Galvanizer, Hyderabad 15. M/s Sigma, Mumbai </td> <td colspan="2"> 16. M/s Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18. Poona Galvanizers Pune 19. Ncha Galvanizer- Kolkata 20. Unitech galvanizers- Hoogly 21. Gurpreet galvanizers- Hyderabad 22- DMP Projects- Kolkata </td> <td colspan="3"> <i>Additional galvanizer/s, if any, proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.</i> </td> </tr> </tbody> </table>									Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS	1. M/s M J Engg, Delhi 2. M/s Jamna Metal, Delhi 3. M/s A.V. Engg, Kolkata 4. M/s Inar Profiles, Vishakapatnam 5. M/s Anand Udyog, Mumbai 6. M/s Techno Engg, Chandigarh 7. M/S Steelite Engg, Mumbai				8. M/s National Galvanizer, Kolkata 9. M/s Unistar Galvanizer, Kolkata 10. M/s B.P. Project. Kolkata 11. M/s Bajaj Pune 12. M/s Electrocure Industries, Mumbai 13. M/s B.G. Shirke, Pune 14. M/s Gurpreet Galvanizer, Hyderabad 15. M/s Sigma, Mumbai		16. M/s Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18. Poona Galvanizers Pune 19. Ncha Galvanizer- Kolkata 20. Unitech galvanizers- Hoogly 21. Gurpreet galvanizers- Hyderabad 22- DMP Projects- Kolkata		<i>Additional galvanizer/s, if any, proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.</i>
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS																				
1. M/s M J Engg, Delhi 2. M/s Jamna Metal, Delhi 3. M/s A.V. Engg, Kolkata 4. M/s Inar Profiles, Vishakapatnam 5. M/s Anand Udyog, Mumbai 6. M/s Techno Engg, Chandigarh 7. M/S Steelite Engg, Mumbai				8. M/s National Galvanizer, Kolkata 9. M/s Unistar Galvanizer, Kolkata 10. M/s B.P. Project. Kolkata 11. M/s Bajaj Pune 12. M/s Electrocure Industries, Mumbai 13. M/s B.G. Shirke, Pune 14. M/s Gurpreet Galvanizer, Hyderabad 15. M/s Sigma, Mumbai		16. M/s Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18. Poona Galvanizers Pune 19. Ncha Galvanizer- Kolkata 20. Unitech galvanizers- Hoogly 21. Gurpreet galvanizers- Hyderabad 22- DMP Projects- Kolkata		<i>Additional galvanizer/s, if any, proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.</i>																						

Note-3 : VDE / CE / UL / CSA MARKING FOR PRODUCT QUALITY: SELF CERTIFICATION/VALID CERTIFICATION FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER WITH CML NO. FOR PRODUCT QUALITY SHALL BE SUBMITTED FOR NTPC's INFORMATION

Handwritten signature
NTPC



Handwritten signature
(JATIN GAHLAWAT)
BHEL

202

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		II				Berhold Technologies	Germany	A			
		*				M and W	Denmark	DR			M/s BHEL will forward only one proposal after details review of NTPC Technical specification requirements.
		*				EMERSON	India	DR			
		*				Yokogawa	Bangalore	DR			
		*				Forbes Marshall	Pune	DR			
11	Furnace Exit Gas Temperature Probe	III				Diamond Power	India /UK/USA	NOTED			
		III				Clyde Bergmann	India /USA	NOTED			
12	Boiler tube leak detection system	II				Procon	UK	A			
		II				Raman Instruments	Delhi	A			M/s Procon, UK make System
		II				Acoustic Monitoring International Inc.	USA	A			
		II				Hi Tech System and Service	Kolkata	A			M/s AMI, USA make System
		II				Instotech	South Africa	A			
		II				Rectusan	Korea	A			
		II				BHELSONIC	Trichy	A			
13	Coal bunker Level monitor	%				%					% - Type, vendor and inspection category will be decided during detail Engineering
14	Tube thickness Meter	III				Main Supplier approved sources		NOTED			
15	POSITIVE DISPLACEMENT FLOW METER/	III				BROOKS	USA	A			Calibration reports to be submitted.
		III				BOPP & ROUTHER	GERMANY	A			
		III				OVAL	JAPAN	A			
		II				Toshniwal corporation Hyvac	Chennai	A			
16	Coriolis Type Mass Flow	III				Krohne	Germany	NOTED			Subject to type acceptance from NTPC Engineering.
		III				E & H	Aurangabad	NOTED			
		III				Siemens	Germany	NOTED			
		III				Yokogawa	Bangalore	NOTED			
		III				Emerson	Pawane	NOTED			
17	Control Valve for Start Up System	II				CCI	USA/Switzerland/ Korea	A			
		II				Tyco Sampell	Germany	A			
		*				EMERSON (Fisher)	USA/France/Japa	DR			Reference list and performance feedback are to
		*				Dressor Masoneilan	France	DR			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				CCI	India	DR			Approved for 840 Series 8 Inch, 600 Class
		*				Daume Regelamaturean GmbH	Germany	DR			M/s BHEL will forward only three proposals after details review of NTPC Technical specification requirements.
		*				Metso Singapore PTE Ltd.	South Korea	DR			
		*				Severn Glocon	Chennai	DR			
		*				Spx Corporation	USA	DR			
		*				Ringo Valvulas SL	Spain	DR			
		*				Valvitalia SPA	Italy	DR			
		*				R K Controls	Thane	DR			
		*				Circor (Leslie)	Coimbatore	DR			
		*				Spx Flow Technologies	USA	DR			
		*				KOSO	Nasik	DR			
		*				Parcol Spa	USA	DR			
		*				Schenjiang valve co. ltd.	China	DR			
		*				Spx Flow Technologies	Ahamadabad	DR			
20	Temperature Transmitter	III				EMERSON	U.S.A/Pawane / Singapore	A			
	(Single and Dual Input)	III				Yokogawa	Japan	A			Final testing at M/S YIL,Bangalore is also acceptable
		III				Moore	USA	A			
		III				M System	JAPAN	A			
		III				ABB	GERMANY/ Bangalore	A			
		III				ENDRESS & HOUSER	Aurangabad	A			M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				Khrone		DR			
		*				Tokyo Keiso	Japan	DR			
		*				Honeywell	Pune	DR			
		*				INOR	Sweden	DR			
		*				P & F	Bangalore	DR			
		*				Siemens		DR			
		*				Yamatake	JAPAN	DR			
		*				Yamari	JAPAN	DR			
		*				Foxboro		DR			
21	Conduits/Pipe(GI)					Refer Electrical List					

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
22	Electronic transmitters (pressure, DP)	III				EMERSON (Rosemount)	USA/ Pawane	A			
		III				FUJI ELECTRIC	China	A			
		III				YOKOGAWA	JAPAN	A			Testing and Calibration at M/s YIL, Bangalore is also acceptable.
		II				ABB	Bangalore	A			Model - 2600 T
		III				ABB	GERMANY / Italy	A			Model - 2600 T
		III				Siemens	France / India	A			
		III				Honeywell	Pune	A			
		*				ENDRESS & HOUSER	Aurangabad/ Germany	DR			
23	Thermocouples, RTD & Thermowell	III				HERAUS SENSOR	GERMANY	A			
		III				WISE Control	Korea	A			
		II				Tempsens	Udaipur	A			
		II				Pyroelectric	Goa	A			
		II				Detriv Instrumentation & Electronics Ltd	Mumbai	A			
		III				Minco	USA	A			
		III				OKAZAKI corporation	JAPAN	A			
		III				Yamari	JAPAN	A			
		III				Yamari	Singapore	A			For RTD Reference list and Performance feedback is to be submitted.
		III				ABB(SENSYCON)	Germany	A			
		III				EMERSON (Rosemount)	Germany	A			
		II				EMERSON (Rosemount)	Pawane	A			Imported from Emerson, Germany (make)
		II				Thermal Instruments(GIC)	Savantwadi	A			
		II				Techno Instruments	Ahamadabad	A			
		II				GOA Instrument Industries	GOA	A			For Thermowell only
		*				GOA Instrument Industries	GOA	DR			M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				WIKA	Pune	DR			
		*				Toshniwal Industries	Ajmer	DR			
		*				E & H	Aurangabad	DR			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				Nesstech	Vapi	DR			
		*				Baumer	Vapi	DR			
24	Ultrasonic type level Transmitter	III				E & H	Aurangabad/ Germany	A			
		III				EMERSON	Pawane	A			
		III				SIEMENS MILTRONICS	CANADA	A			
		III				Nivelco	Hungary	A			
		*				Vega	Germany	DR			M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				Khrone	France / USA / Pune	DR			
		*				Yokogawa	Bangalore	DR			
		*				Honeywell	India	DR			
		*				Magnetrol	Belgium	DR			
		*				ABB	Germany / India	DR			
25	Orifice plate assembly	III				Instrumentation Limited	Palghat	A			
		III				Microprecision	Faridabad	A			
		III				Starmech	Pune	A			
		III				Flow Star	Faridabad	A			
		III				SEIKO	Austria	A			
		III				MINCO (GIC)	GOA	A			
		III				WISE Control	Korea	A			
		III				T M Technomatic	Italy	A			
		*				IEPL	Hyderabad	DR			
		*				Engg. Specialities	Kolkata	DR			
		*				BALIGA	CHENNAI	DR			
		*				Pyroelectric	Mumbai	DR			
		*				Hydropneumatics	Mapusa	DR			
26	Pressure, DP Gauge	III				BUDENBERG	UK	A			
		III				ASHCROFT	USA/Germany/ India	A			
		III				Wika	GERMANY	A			
		III				WISE Control	Korea	A			
		III				Nagano KEIKI	Japan	A			
		III				H.Guru South India	Bangalore	A			Not for MS & FW application
		III				A.N. Instruments	Kolakatta	A			Not for MS & FW application
		III				Gauge Bourdon(GIC)	Parvel	A			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Goa Thermostatic	GOA	A			Not for MS & FW application
		III				Wika	Pune	A			DR for MS & FW application
		III				Baumer	Vapi	A			DR for MS & FW application
		III				Ashcroft (Mass Brand)	Gandhinagar	A			Not for MS & FW application
		III				H Guru	Rishra/Muzaffarpur	A			Not for MS & FW application
		*				US Gauge	USA	DR			
		*				Winters	USA	DR			
		III				Forbes Marshall	Hyderabad	A			
		*				Manometer	Mumbai	DR*			
		III				Walchandnagar Industries Ltd.	Dharwad	A			
		*				Nesstech	Vapi	DR			
		*				Gauges Bourdon	UK	DR			
27	Level gauge (Transperent & Reflex, Tubular type)	III				Nihon Klingage Co.,Ltd	Japan	NOTED			
		III				Bunkaboeki Kogyo Co., Ltd	Japan	NOTED			
		III				tokyo keiso	Japan	NOTED			
		III				Chemtrol Samil (I) Pvt. Ltd.	Mumbai	NOTED			
		III				Levcon	Kolkatta	NOTED			
		III				Sigma	Mumbai	NOTED			Up to 40 Kg/cm2
		III				SBEM	Pune	NOTED			Up to 40 Kg/cm3
		III				Chemtrol	GOA	NOTED			Up to 40 Kg/cm4
		III				ASIAN INDUSTRIAL VALVES	CHENNAI	NOTED			Up to 40 Kg/cm5
		III				D.K.Instruments	Kolkotta	NOTED			Up to 40 Kg/cm2
		III				Flow Star	Faridabad	NOTED			Up to 40 Kg/cm2
		III				V-Automat	NewDelhi	NOTED			
		III				DEMPER KOGYO	JAPAN	NOTED			
		III				Kubler	Germany	NOTED			
		III				WIKAI	PUNE	NOTED			Up to 40 Kg/cm2
		III				WAREE	VAPI	NOTED			Up to 40 Kg/cm2
		III				Gauges Bourdon (GIC)	Panvel	NOTED			
		III				Magnetrol	Belgium	NOTED			
		III				Khrone	Germany	NOTED			
		III				PUNE TECHTROL	Pune	NOTED			
		III				E & H	Aurangabad	NOTED			
28	Press, DP, Vaccum Switch	III				SOR	USA	A			
		III				DRESSOR (ASHCROFT)	USA/Germany	A			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				ITT BARTON	USA	A			
		III				HERION	GERMANY	A			
		III				BARKSDALE	GERMANY	A			
		*				Nagano KEIKI	Japan	DR			
		I				Switzer Process Instrument	Chennai	A			Up to 40kg/cm2 & not for Compound Switch and except 900 series
		I				Trafag	Gurgaon	A			Up to 40kg/cm2 & not for Compound Switch
		I				Switzer Process Instrument	Ghaziabad	A			Up to 40kg/cm2 & not for Compound Switch
		III				Delta control	UK	A			
		I				Gauges Bourdon (GIC)	Panvel	A			Up to 40kg/cm2 & not for Compound Switch
		I				ASHCROFT	Gandhinagar	A			
		*				Wika	Pune	DR			
		III				Gorgeion	France	A			
		III				United Electric	USA	A			
		*				SMC	Japan	DR			
		*				Neodyne	USA	DR			
		*				IMI NORGEN	Noida	DR			
		*				WISE Control	Korea	DR			
		*				Baumer	Vapi	DR			
29	Temperature Switch	III				SOR	USA	A			
		III				DRESSOR (ASCHROFT)	USA/Germany	A			
		III				ITT BARTON	USA	A			
		III				DELTA CONTROLS	UK	A			
		I				Switzer Process Instrument	Chennai	A			up to 200 Deg. C
		I				Switzer Process Instrument	Ghaziabad	A			up to 200 Deg. C
		I				Trafag	Gurgaon	A			up to 200 Deg. C
		I				ASHCROFT	Gandhinagar	A			
		*				Wika	Pune	DR			
		III				Gorgeion	France	A			
		III				United Electric	USA	A			
		*				SMC	Japan	DR			
30	Flow switch	III				UNIVERSAL FLOW METER	USA	A			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Switzer	Chennai	A			
		III				Levcon	Klokatta	A			
		III				DK Instrument	Kolkatta	A			
		III				Khrone Marshal	Pune	A			
		III				Chemtrol	India	DR			
		III				V Automat	NewDelhi	DR			
		III				Gauges Bourdon	Panvel	A			
		III				Magnetrol	Belgium	A			
		III				Ashcroft	Germany	A			
		III				Auxitrol	UK	A			
		III				Mericaid	USA	A			
		III				Delta Control	UK	A			
		III				Merium	USA	A			
		*				Sunag Corporation		DR			
31	Condensing Pots	III				INSTRUMENTATION LIMITED	PALGHAT	NOTED			
		III				MICRO PRECISION	FARIDABAD	NOTED			
		III				WOOJIN	Korea	NOTED			
		III				SAM IL	Korea	NOTED			
		III				Excel Hydro	Mumbai	NOTED			
		III				Flow tech	Calcutta	NOTED			
		III				Baldota	Mumbai	NOTED			
		III				Precision	Mumbai	NOTED			
		III				Metpress	Calcutta	NOTED			
		III				HP Valves and fittings	Chennai	NOTED			
		III				Main Contractor Approved Sources		NOTED			
32	Electric to Pneumatic converter	III				IMI NORGEN	India	A			Make : WATSON SMITH
		III				Fair child	USA	A			
		*				ABB	India	A			Subject to meeting the NTPC specificaton requirement
		*				SMC Pneumatics	Noida	DR			
		*				P & F	Bangalore	DR			
		*				Fairchild India Pvt. Ltd.	Noida	DR			
		*				FESTO	Bangalore	DR			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		II				Sumitomo/kawasaki/Nippon	Japan	A			
		II				TPS TECHNITUBE	Germany	A			
		II				Veluric & manessmann	Germany	A			
		II				BHEL	Trichy	A			
		II				Trouvay and Cauvin	France	A			Makes shall be as per approved list (Sr. No. 41)
		II				ISMT	Ahamadnagar	A			Carbon steel only.
		II				Sandvik		A			For SS only.
		*				TUBACES	Spain	DR			
		*				Salzgitter Mannesmann International	Germany	DR			
		*				Jindal saw	India	DR			
		II				Ratanamani Metal and Tubes	Ahamadabad	A			SS only
		II				Heavy metals and Tubes	Ahamadabad	A			SS and CS only.
		*				Shubhalaxmi Metal and Tubes	Mumbai	DR			
39	Compression fittings	III				Parker	USA	A			
		III				Precision	Mumbai	A			
		III				Astech	Mumbai	A			
		III				Fluid control Pvt. Ltd.	Pune	A			
		III				HP Valves and fittings	CHENNAI	A			Ferruleas are to be hardned at Exim Holand for pressure above 9000 psi.
		III				Excel hydro	Mumbai	A			Ferruleas are to be hardned at Exim Holand for pressure above 9000 psi.
		III				Swagelock	USA	A			
		III				Panam	Mumbai	A			
		*				Parker Hannifin India Pvt. Ltd.		DR			
		*				Prime Engineers		DR			
		*				Arya Craft		DR			
40	Instrument valves	III				BHEL	Trichy	A			
		II				Excel Hydro	Mumbai	A			
		II				Instrumentation Ltd.,	Palghat	A			
		III				Swagelok	USA	A			
		III				Parker	USA	A			
		II				HP Valves and fittings	CHENNAI	A			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		II				Fluid control Pvt. Ltd.	Pune	A			
		II				Baldota	Mumbai	A			
41	Valve manifolds	III				Excel hydro	Mumbai	A			
		III				SCHNEIDER	Germany	A			
		III				Anderson Greenwood	USA	A			
		III				Astech	Mumbai	A			
		III				HP Valves and fittings	CHENNAI	A			
		III				Fluid control Pvt. Ltd.	Pune	A			
		III				Microprecision	Faridabad	A			
		III				Parker	USA	A			
		III				Swagelock	USA	A			
		III				Baldota	Mumbai	A			
		*				Metpress Engg. works	Kolkata	DR			
42	Local Instrument Enclosure/Rack	I				Pyrotech	Udaipur	A			
		I				Instrumentation Limited	Kota	A			
		I				Sajas electrical	Trichurapalli	A			
		I				Prammen	Puddukottai	A			
		I				Chemin	Pondicherry	A			
		*				Forbes Marshall	Pune	DR			
		*				Positronics	Vadodara	DR			
		*				Procon	Chennai	DR			
43	Instrument Cables	I				Paramount	Khushkhera	A			PVC,FRLS type,RQP
		I				Polycab	Daman	A			PVC,FRLS type,RQP
		I				Delton	Faridabad	A			PVC,FRLS type,RQP
		I				KEI	Bhiwadi	A			PVC,FRLS type
		I				Elkey Telelinks	Faridabad	A			PVC,FRLS type
		I				CORDS	Chopanki	A			PVC,FRLS type,RQP
		I				CORDS	Kaharani	A			PVC,FRLS type,RQP
		I				Nicco	Kolkata	A			PVC,FRLS type
		II				TEW & C	USA	A			
		II				Habia cables	Sweeden	A			
		II				Kerpen cables	Germany	A			
		II				Lapp cables	Germany	A			
		II				Thermo elecrt Bv	Netherland	A			
		I				Universal Cable	Satna	A			PVC,FRLS type

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				Thermocables	Hyderabad	A			
		I				Finolex Cable	Pune	DR *			
		I				Incab	Pune	DR *			
		I				Gupta Power Infrastructure Ltd.	Khurdha	A			
		*				Lapp cables	India	DR			
		*				Lioni cable	Pune	DR			
		*				RR Kabel	Silvasa	DR			
		*				Gemscab	Bhiwadi	DR			
		*				KEC International	Mysore	DR			
		*				Advance cable Technologies	Bangalore	DR			
		*				Suyog Electricals Ltd.	Vadodara	DR			
		*				Special Cable	India	DR			
		*				CMI	Faridabad	DR			
44	Electrical actuator	III				Auma	Germany	A			
		III				Limitorqe	USA	A			
		III				Rotorq	UK	A			
		II				Limitorque	Faridabad	A			
		II				Rotork	Chennai/ Bangalore	A			
		III				Nippon gear	Japan	A			
		II				Auma	Bangalore	A			
		III				Harold Beck	USA	A			
		III				Drehmo	Germany	A			
		*				Lindco	USA	DR			
		*				Siemens	Germany	DR			
45	Electrical actuator for ID/FD/PA Blade pitch and Guide vane control	III				Harold Beck	USA	A			
		III				SIPOS Aktorik GmbH	Germany	A			
		*				ABB	Germany	DR			
46	Flow nozzle / Vernturi assembly	II				Microprecision	Faridabad	A			
		II				SEIKO	Austria	A			
		II				TECHNOMATIC	Italy	A			
		II				Instrumentation Limited	Palghat	A			
		II				Starmech	Pune	A			DR for P-91 Material
		II				WISE Control	Korea	A			

M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				SAMIL	Korea	DR			
		*				MINCO	GOA	DR			
		*				Engg. Specialities	Kolkata	DR			
		*				Pyroelectric	Mumbai	DR			
		*				Hydropneumatics	Mapusa / GOA	DR			
		*				ASIAN INDUSTRIAL VALVES	Chennai	DR			
47	HIGH Temp. cable (PTFE/FEP)	II				Habia cables	Sweden	A			
		II				Lapp cables	Germany	A			
		II				Kerpen cables	Germany	A			
		II				TEW & C	USA	A			
		II				Thermo-Electra Bv	Netherland	A			
		II				Habia cables	China	A			
		II				Thermocables	Hyderabad	A			
		*				Tempsens	Udaipur	DR			
		*				Delton Cables	Faridabad	DR			
		*				RJ Cables	Roorkee	DR			
48	Fiber optic cable	II				HFCL	Goa	A			
		II				R&M	Switzerland	A			
		II				Aksh Fibre	Bhiwadi	A			
		II				Finolex	Pune/Goa	A			
		II				Birla Ericson	Rewa	A			
		II				Molex	UK	A			
		II				Corning	USA	A			
		II				Schneider	GOA	Noted			Previously known as D Link / Smarlink, Goa
		*				RPG Cables	India	DR			
		*				Uniflex Cables	India	DR			
49	Pneumatic Actuator (Power Cylinder e. g. FOR SADC)	II				Dong Woo Valve Control Co. LTD	Korea	A			
		II				Shin Hwa Engineering Co. LTD	Korea	A			
		I				Instrumentation Limited	Palghat	A			
		I				Kelton	Cochin(Alleppy)	A			
		I				SMC Pneumatics	Noida	A			Up to 12 inch only
		I				Rotex	Mumbai	A			Conditional
		*				Emerson Process Management	Chennai	DR			
		*				MIL Controls	Alwaye	DR			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				Festo	Bangalore	DR			
		*				IMI Norgen	Noida	DR			
50	Level switch capacitance type	III				ENDRESS & HOUSER	Aurangabad	A			
		III				MAGNETROL	BELGIUM	A			
		III				SBEM	PUNE	A			
		III				PUNE TECHTROL	PUNE	A			
		III				LEVCON	KOLKATA	A			
		III				Nivo Controls	Indore	A			
		*				V AUTOMAT	New Delhi	DR			
		*				D K Instrument	Kolkata	DR			
		*				Siemens	Germany	DR			
		*				ABB	Korea	DR			
		*				Rosemount	Korea	DR			
51	Transducer	II				AE	Mumbai	A			
		II				Southern Transducer	Chennai	A			
		II				Elster	Mumbai	A			
		III				Camille Bauer	Germany	A			
		III				Metrawat	Germany	A			
		II				Rishab	Nasik	A			
		*				Pyrotech	Udaipur	DR			
		*				Masibus	Gandhinagar	DR			
		*				SIEMENS	Germany	DR			
52	Mini UPS up to 3.5 KVA	III				EMERSON	Mumbai	A			
		III				EMERSON	Pune	A			
		III				Hitachi Hi- Rel	Gandhinagar	A			
		III				APC	Bangalore	A			
		III				APLAB	Mumbai	A			
		III				Delta	Gurgaon	A			
		*				Powertronix	Bangalore	DR			
		*				Schneider	Bangalore	DR			Submit one proposal only
53	Level switch- cond type	III				EMERSON (Solartron mobrey)	UK	A			
		II				Hi Tech	Kolkata	A			Levelstate, UK System
		III				Yarway	USA	A			
		III				LEVELSTATE	UK	A			
		II				Raman Instruments	Delhi	A			Emerson (Mobrey) System
		*				BHEL	Trichy	DR			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Jafferson	Argentina	A			
		III				Asco	Chennai/USA	A			
		III				Festo	Bangalore	A			
		III				SMC	Noida	A			
		III				Parker	Brand Name	A			
		*				Schneider	Germany	DR			
		*				Neucon Industries Pvt. Ltd.		DR			
59	Lube oil control valve - Self Regulating	III				NUOVO PIGNONE	ITALY	A			
		III				EMERSON	CHENNAI	A			
		III				SAMSON	GERMANY / PUNE	A			
		III				Forbes Arca	Pune	A			Approved up to 4", 150 Class.
60	Guided waveRadar type level transmitter	III				Magnetrol	Belgium	A			
		III				Endress & Houser	Germany/ Aurangabad	A			
		III				Emerson Process Management	Sweden/	A			
		III				ABB(K-Tech)	USA	A			
		*				Yokogawa	Japan	DR			
		*				ABB	India	DR			
		*				P & F	Bangalore	DR			
		*				Khrone	France	DR			
		*				HONEYWELL	Pune	DR			
		*				Vega	Germany / India	DR			
		*				Siemens	India	DR			
		*				SBEM	Pune	DR			
61	Maintenance and Calibration Equipment					Main Contractor will propose the vendors during detail Engineering.					
62	Temperature Gauge	III				BUDENBERG	UK	A			
		III				DRESSOR (ASHCROFT)	USA/Germany	A			
		III				Wika	GERMANY/ Pune	A			
		III				WISE Control	Korea	A			
		III				Nagano KEIKI	Japan	A			
		III				H.Guru South India	Bangalore	A			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		#				Siemens		N			
		#				Smar		N			
		#				Yokogawa		N			
		#				EMERSON (Fisher Rosemount)		N			
		#				METSO		N			
		#				Yamatake		N			
		#				Moore		N			
68	ROTAMETER	III				IEPL	HYDRABAD	A			
		III				TRAC	HYDRABAD	A			
		III				PLACKA	CHENNAI	A			
		III				EUREKA	PUNE	A			
		III				SCIENTIFIC DEVICES	MUMBAI	A			UP TO 300 NB
		III				FLOW STAR	FARIDABAD	A			
		III				TOKOYO KEISO	JAPAN	A			
		*				Flowtech Instrument Services	Vadodara	DR			
		*				Samil Chemtrol	MUMBAI	DR			
		*				Gauges Bourdon	Panvel	DR			
69	SINGLE AND MULTI POINT TEMPERATURE RECORDER (Micorprocessor based)	III				YOKOGAWA INDIA	BANGALORE	A			Make Yokogawa, Japan
		III				CHINO CORPORATION	JAPAN	A			
		III				EUROTHERM	UK	A			
		III				EUROTHERM	INDIA	DR			
		III				YOKOGAWA	JAPAN	A			
		III				ABB	UK / GERMANY	A			
		III				FUJI	JAPAN	A			
		III				HONEYWELL	USA / NETHERLAND	A			
70	Reverse Rotation Indicator (RRI)	III				GE BENTLY NEVEDA	USA	A			ALL TSI VENDORS ARE ALSO ACCEPTABLE
		III				SHINKAWA	JAPAN	A			
		*				P & F	GERMANY	DR			
71	Instrument Tube Fittings (Air)					Main Supplier approved sources		NOTED			
72	pH/ Conductivity Analyser	III				HACH	Switzerland / USA	A			
		III				YOKOGAWA	Banglaore / Japan	A			Make Yokogawa- Japan
		III				ABB	UK / USA	A			

No.	Major Equipment	QP Inspection Category	QP No. 9582 001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				EMERSON	Pawane	A			
		*				Thermo orion		DR			
73	PADO					Main Contractor will propose the vendors during detail Engineering.					
74	DEW Point Sensor / meter	III				GE Sensing	USA / Ireland	A			Panametric brand
		III				Michell Instrument	UK	A			
		III				Shaw	UK	A			
		*				COSA XENTAUR	USA	DR			
		*				VAISHALA	Sweden / Japan	DR			
		*				DWER	USA	DR			
		*				Endee	Mumbai	DR			
75	Blank Panels / Cabinets	III				Rittal	Bangalore	A			
		III				Hoffman	BANGALORE	A			
		III				Pyrotech	Udaipur	A			
		III				BHEL	Bangalore	A			
		III				Schneider	Bangalore	DR			
76	CCTV Components (IP)	*				Sony	Japan	DR			
		*				Siemens	Pondichery	DR			
	Integrators will be decided during detail Engineering.	*				Dv Tel	USA	DR			
		*				Honey Well	Gurgaon	DR			
		II				Bosch	Bangalore	A			With Bosch Software
		II				Axis	Sweden	DR			With Bosch Software
		*				Pelco	USA	DR			
		II				Axis	Sweden	DR			With Milestone Software
77	Control Desk, Server / PC Rack for Unit Control room and Auxillary control room.	I				Pyrotech works Space	Udaipur	A			
		I				Cosmos	Noida	A			
		I				Adarsh Control	Bangalore	A			
		*				Chemin Controls	Pondichery	DR			
		*				Harmony Systems	New Delhi	DR			
78	Digital Indicators	III				Masibus	Gandhi Nagar	A			For Non mosaic mounting
		III				ABB	Germany	A			
		III				Foxboro	UK	A			
		III				Yokogawa	Japan	A			

APPROVED VENDOR LIST - BHEL

Package Name	Supplier Name	Supplier Communication Address	Tech Limit
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, No.127 & 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : marketing@switzerinstrument.com	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdesh@sherman-india.com,	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,	
ANALYTICAL INSTS.SAMPLE COOLER	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Patthankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	
ANALYTICAL INSTS.SAMPLE COOLER	FORBES MARSHAL PVT. LTD.	A-33/34, MIDC ESTATE, H-BLOCK, PIMPRI, PUNE Phone- 27470171,27477472 Pincode : 411018 Email : nkaushal@forbesmarshall.com	
ANALYTICAL INSTS.SAMPLE COOLER	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	
TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	
TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	
TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	
TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in	
TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	
TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	
TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	
TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	
TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	
TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in	
TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	
TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTRIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com	

TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone-9920576002 Pincode : 396105 Email : sales@nesstech.co.in	
TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema, Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com	
TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	
TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	
TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	
TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	
TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A. UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com	
TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
TRANSMITTERS	Pune Techrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechrol.com	Only for capacitance Type Level Transmitter
TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	
TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	"Except Displacement Type Level Transmitters"
TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	
TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	FOR CAPACITANCE TYPE.
TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	
TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business, Parsiwada, Sahar road, Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	For Pressure and Diff. Pressure transmitter
TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	
TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Pattharankar/Vikram Raj Singh 206-210, BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	
TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	
TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delby.rpgms.ems.vsnl.net.in	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	For Capacitance type only
TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdesh@sherman-india.com,	
TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	
TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	
TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, No.127 & 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044 26252017/2018 Pincode : 600050 Email : marketing@switzerinstrument.com	
SIGHT FLOW INDICATORS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	
SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	
SIGHT FLOW INDICATORS	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	
SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : ieddelhi@leflowmeters.com	
SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	
SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com	
JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net	
JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	
JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com	
JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Metal type junction box only

JUNCTION BOX	AJMER INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMER DENA BANK BLDG., SHREE NAGESH INDL. ESTATE, STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
Cold Junction Compensation Box (CJCB)	CREATIVE INSTRUMENTS & CONTROLS	NO-17/1, 1ST FLOOR, 11TH CROSS 1ST K BLOCK, RAJAJINAGAR, BANGALORE-560010 Phone Pincode : Email : crinstruments@gmail.com
INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7, SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD, GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
ROTAMETER	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedehi@iefloflowmeters.com
ROTAMETER	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in
ROTAMETER	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41, Om Anand Industrial Est. Mohanjee Sundarjee Road, Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com
ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com
ROTAMETER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7, SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD, GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
ULTRASONIC FLOW METERS	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4, S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com
ULTRASONIC FLOW METERS	FLEXIM Flexible Industriestechnik GmbH	Boxberger Str., 4, Berlin Berlin Phone- 0049 30 93 66 76 60 Pincode : 12681 Email : info@flexim.de
ULTRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com
ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delhi, Orchard Avenue Road, Powai Mumbai Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in
ULTRASONIC FLOW METERS	Electronet Equipments Pvt Ltd.	Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 020-2026932039 Pincode : 411048 Email : ho@eeplindia.com
ULTRASONIC FLOW METERS	NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com
INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7, SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD, GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal, 216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3, 292, Bellasis Road, Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business, Parsiwada, Sahar road, Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4, S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com
ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.	Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 020-2026932039 Pincode : 411048 Email : ho@eeplindia.com
ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com

- The above sub-vendor list is tentative & reference only. However Sub-Vendor List is subject to BHEL/ end user approval without any commercial/ delivery implication.
- New Sub-Vendor if proposed by Vendor during contract stage shall subject to BHEL/ end user approval without any commercial/ delivery implication.

3 X 800MW PATRATU STPS

ANNEXURE - II

(MDL WITH SUBMISSION SCHEDULE)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

MDL FOR CAS PACKAGE FOR 3X800MW PATRATU STPS						
S. N.	DRAWING NO.	DRAWING TITLE	PURPOSE	TYPE OF DRAWING	SCHEDULED SUBMISSION, DAYS FROM LOI DATE	RESUBMISSION AFTER INCORPORATING COMMENTS (IN DAYS)
1	PE-V0-434-555-A001	QUALITY PLAN OF AIR COMPRESSOR	A-CUST	MC	21	7
2	PE-V0-434-555-A002	QUALITY PLAN OF AIR DRYING PLANT	A-CUST	MC	21	7
3	PE-V0-434-555-A003	QUALITY PLAN OF AIR RECEIVER	A-CUST	MC	25	7
4	PE-V0-434-555-A004	QUALITY PLAN OF VALVES	A-CUST	MC	25	7
5	PE-V0-434-555-A005	TDS AND GA OF AIR COMPRESSORS INCLUDING PERFORMANCE CURVES	A-CUST	MC	21	10
6	PE-V0-434-555-A006	TDS AND GA OF AIR DRYING PLANT	A-CUST	MC	21	10
7	PE-V0-434-555-A008	TDS & GA OF VALVES FOR COMPRESSED AIR SYSTEM	I-CUST	MC	42	10
8	PE-V0-434-555-A014(2 nos. sheets)	TDS AND GA DRAWING OF AIR RECEIVER.	I-CUST	MC	25	10
9	PE-V0-434-555-A015	COMPRESSOR HOUSE LAYOUT	A-CUST	D	30	10
10	PE-V0-434-555-A016	P & I DIAGRAM OF AIR COMPRESSOR	I-CUST	MC	21	10
11	PE-V0-434-555-A017	P&I DIAGRAM OF AIR DRYER	I-CUST	MC	21	10
12	PE-V0-434-555-A019	Control System write up & Config drg/ for Compressed Air System	A-CUST	D	42	10
13	PE-V0-434-555-A020	TERMINAL DETAILS AND WIRING DIAGRAM OF LCP FOR COMPRESSOR CONTROLS & Air Drier CONTROLS for Compressed air system	I-CUST	MC	50	10
14	PE-V0-434-555-A023	CAS PG TEST PROCEDURE	A-CUST	D	75	10
15	PE-V0-434-555-A024	O&M MANUAL-COMP AIR SYSTEM	I-CUST	D	90	10
16	PE-V0-434-555-A025	Datasheet of Instrument (including , Temperature elements, Transmitters and Local Indicators), I/O List, BOM and Mandatory spares for compressed air system/	I-CUST	MC	42	10
17	PE-V0-434-555-A029	SUB-VENDOR LIST & INSPECTION CATEGORISATION SCHEDULE	A-CUST	B	15	10
18	PE-V0-434-555-A751	ELECTRICAL FEEDER LIST	I-G-P	D	21	10
19	PE-V0-434-555-A752	CONTROL CABLE SCHEDULE	I-G-P	D	60	10
20	PE-V0-434-555-A753	I/O List for CAS system.	I-CUST	D	56	10

NOTES

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
- 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.
- Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.
- Bidder to note that during detailed engineering, drwg/doc will be submitted through web based document management system in addition to hard copies to be submitted as per drawing/document distribution schedule. Procedure for the same shall be informed after award of contract.
- MC stands for Manufacturing Clearance, B stands for Basic and D stands for Detailed.
- *I-G-P stands for 'INTERNAL GENERATION PURPOSE'.

3 X 800MW PATRATU STPS

ANNEXURE - III

(INPUT DRAWINGS OF TENDER)

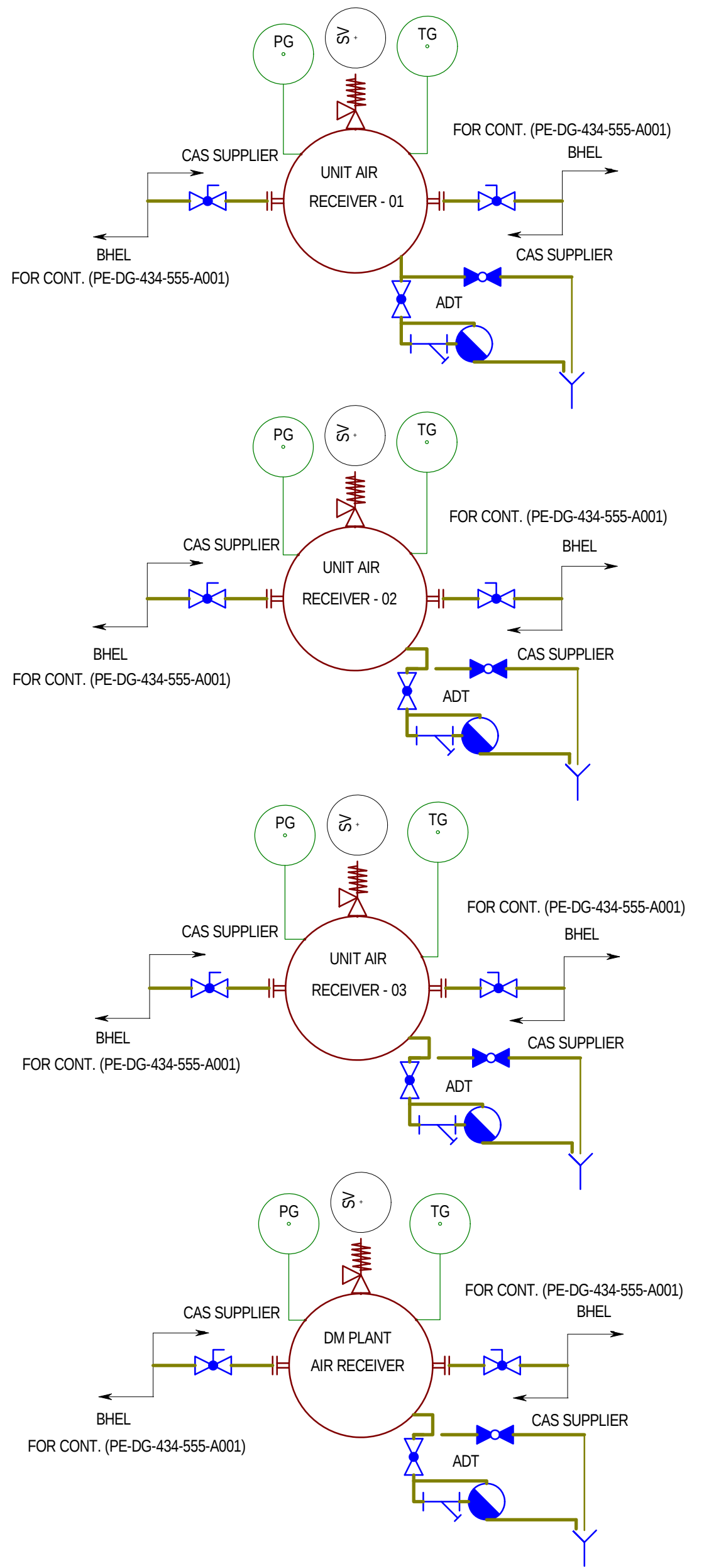
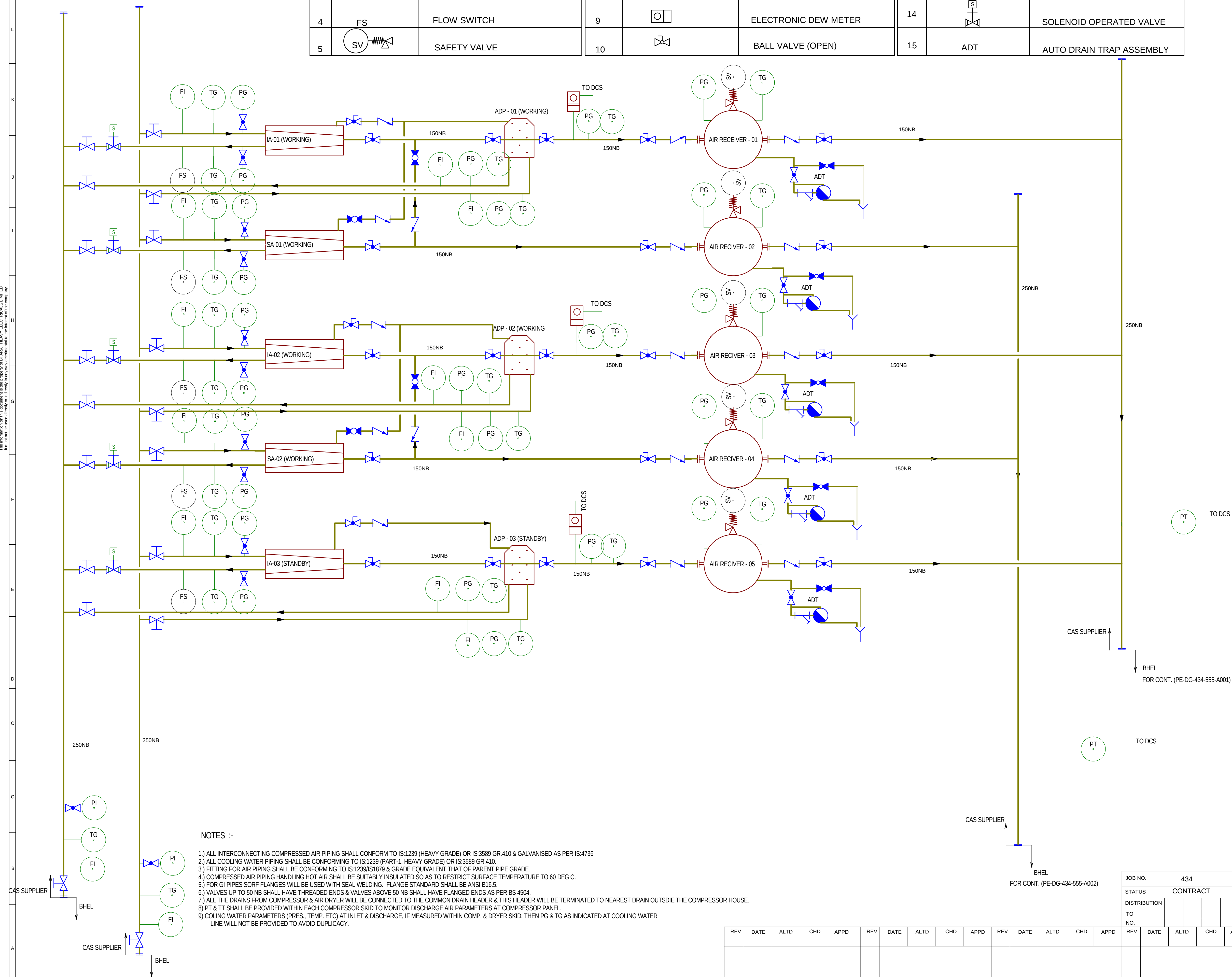


BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

List of Drawings, for tender estimation purpose only, enclosed with the technical specification

SNO	DESCRIPTION
1	PID FOR COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE
2	TENDER DRAWING OF CAS PACKAGE
3	COMPRESSOR HOUSE LAYOUT

13			12			11			10			9			8			7			6			5																				
1	PG	PRESSURE GAUGE	6	IA	INSTRUMENT AIR COMPRESSOR	11		BALL VALVE (NORMALLY CLOSED)	2	TG	TEMPERATURE GAUGE	7	SA	SERVICE AIR COMPRESSOR	12		GATE VALVE	3	FI	FLOW INDICATOR	8	ADP	AIR DRYING PLANT	13		NRV	4	FS	FLOW SWITCH	9		ELECTRONIC DEW METER	14		SOLENOID OPERATED VALVE	5		SAFETY VALVE	10		BALL VALVE (OPEN)	15	ADT	AUTO DRAIN TRAP ASSEMBLY



CUSTOMER : NTPC LTD.
NTPC DRG. NO. : 9585-001-102-PVM-L-144

3X800MW PVUNL PATRATU TPP PHASE-1



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE	DRN	NAME	SIGN.	DATE
	DESN	RK	RK	31.05.2016
	CHD	HK	HK	31.05.2016
	ABDD	EXP	EXP	31.05.2016

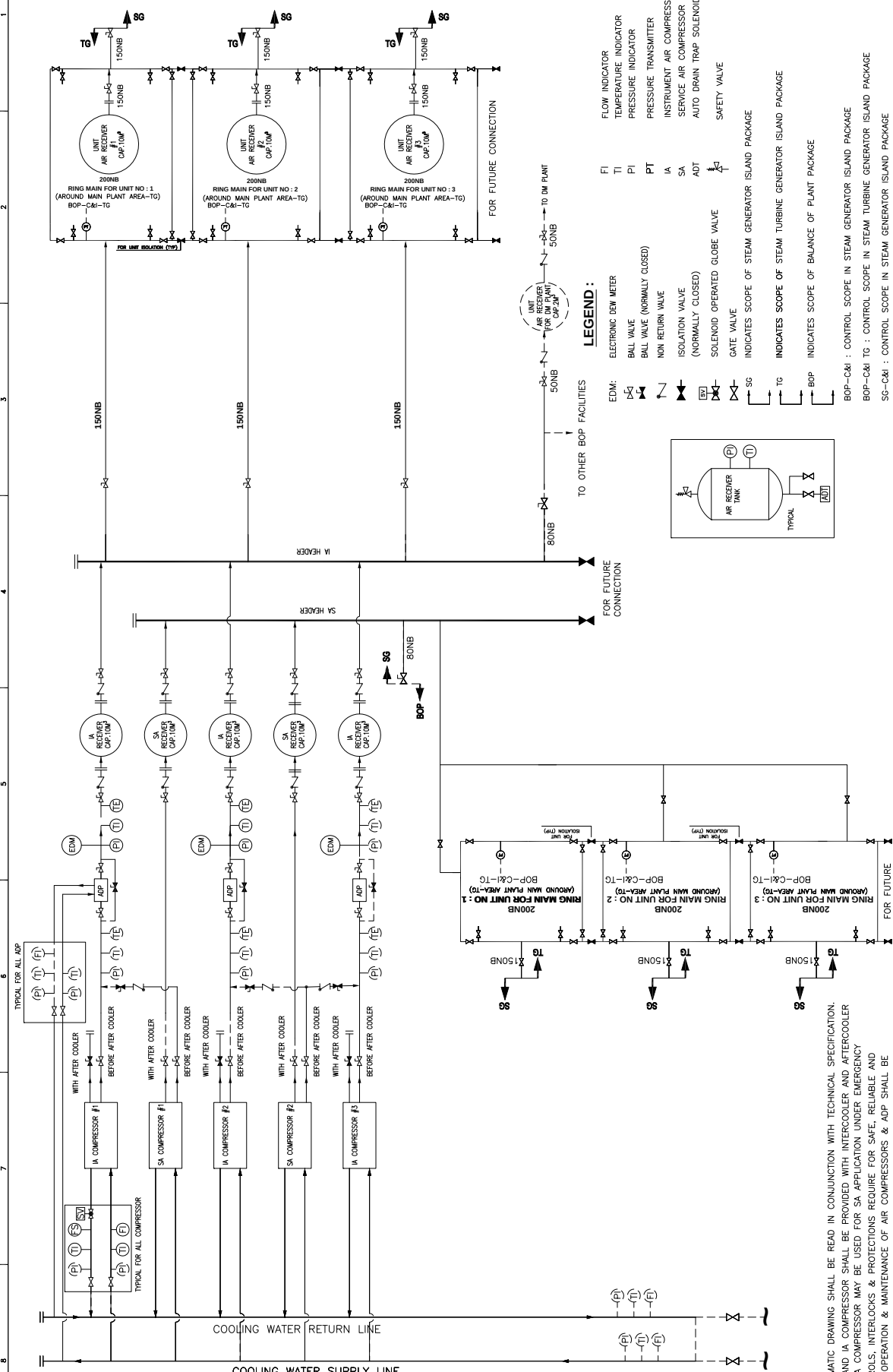
TITLE: P&ID FOR COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE
(WITH ROTARY TYPE HOC AIR DRYER)

									DEPT.	SCALE	Drawing No.
									SIGN		PE-DG-434-555-A018
									DATE		SHEET SHEET 1 OF 2 28/06/2018 00

NOTES :

1. THE SCHEMATIC DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.
2. EACH SA AND IA COMPRESSOR SHALL BE PROVIDED WITH INTERCOOLER AND AFTERCOOLER SO THAT IA COMPRESSOR MAY BE USED FOR SA APPLICATION UNDER EMERGENCY
3. ALL CONTROLS, INTERLOCKS & PROTECTIONS REQUIRE FOR SAFE, RELIABLE AND EFFICIENT OPERATION & MAINTENANCE OF AIR COMPRESSORS & ADP SHALL BE IMPLEMENTED IN CONTROL SYSTEM.
4. ALL IMPORTANT & CRITICAL MEASUREMENTS REQUIRED FOR PROTECTION OF EQUIPMENTS SHALL BE PROVIDED WITH REQUIRED/ADEQUATE
5. VARIOUS FIELD INSTRUMENTS ON AIR AND WATER HAVE BEEN SHOWN, HOWEVER ANY OTHER ADDITIONAL INSTRUMENTS REQUIRED FOR THE SYSTEM SHALL BE PROVIDED BY THE CONTRACTOR AT NO ADDITIONAL COST TO EMPLOYER.
6. UNLOADING/MODULATION OF COMPRESSORS, REPRESSURISATION/DEPRESSURISATION OF ABSORBER TOWER OF ADP & THE SAME SHALL BE PROVIDED BY RESPECTIVE CONTRACTOR.
7. UNIT AIR RECEIVER (FOR IA SYSTEM) SHALL BE LOCATED IN BC BAY OF TG BUILDING.
8. COOLING WATER SHALL BE CLOSE CIRCUIT DM WATER.
9. THE SCHEME HAS BEEN ENVISAGED CONSIDERING HEAT OF COMPRESSION TYPE AIR DRYER (TWIN TOWER TYPE) IN CASE OF ROTARY DRUM TYPE (HOC) AIR DRYER, SCHEME SHALL BE FINALISED DURING DETAILED ENGINEERING

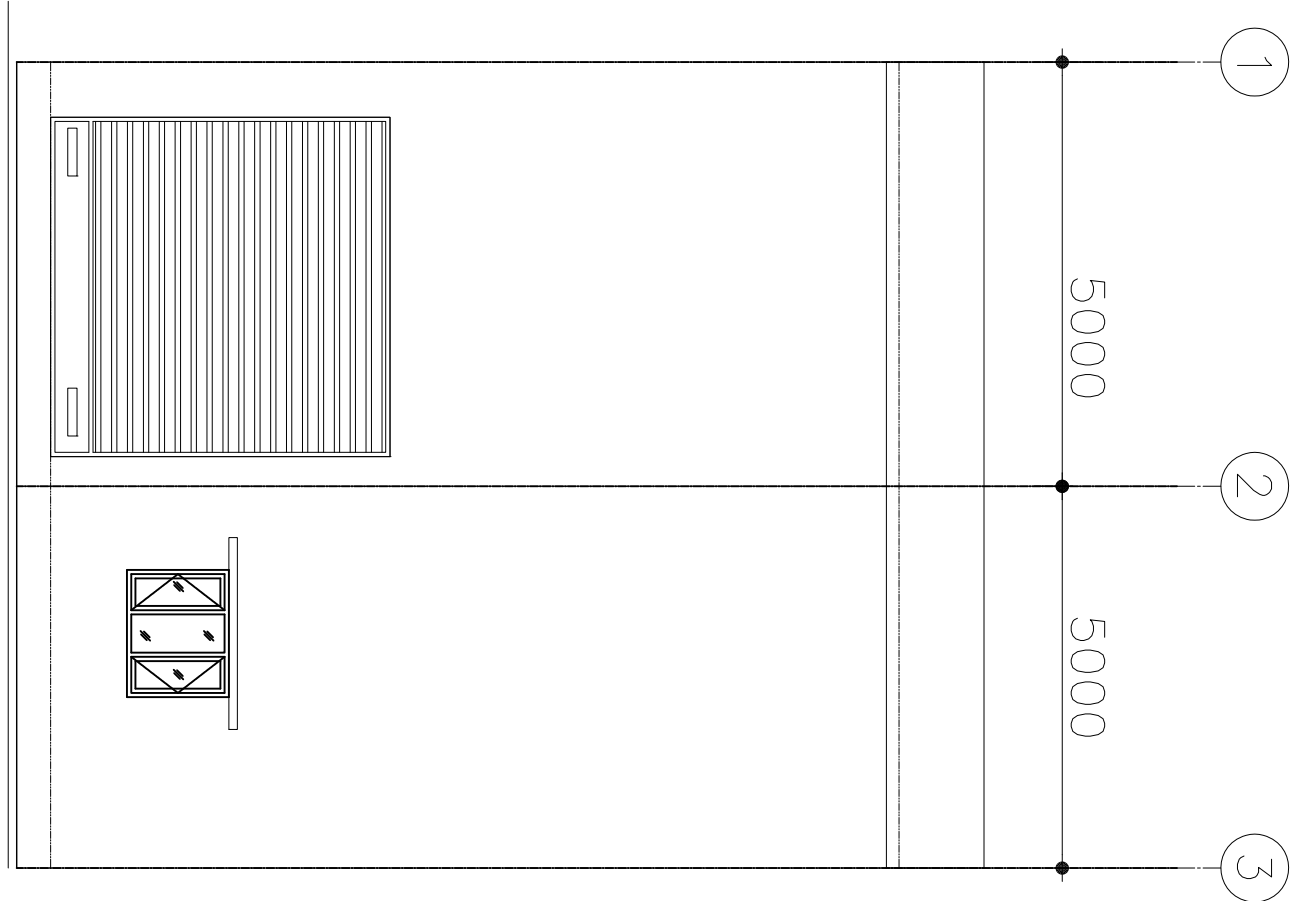
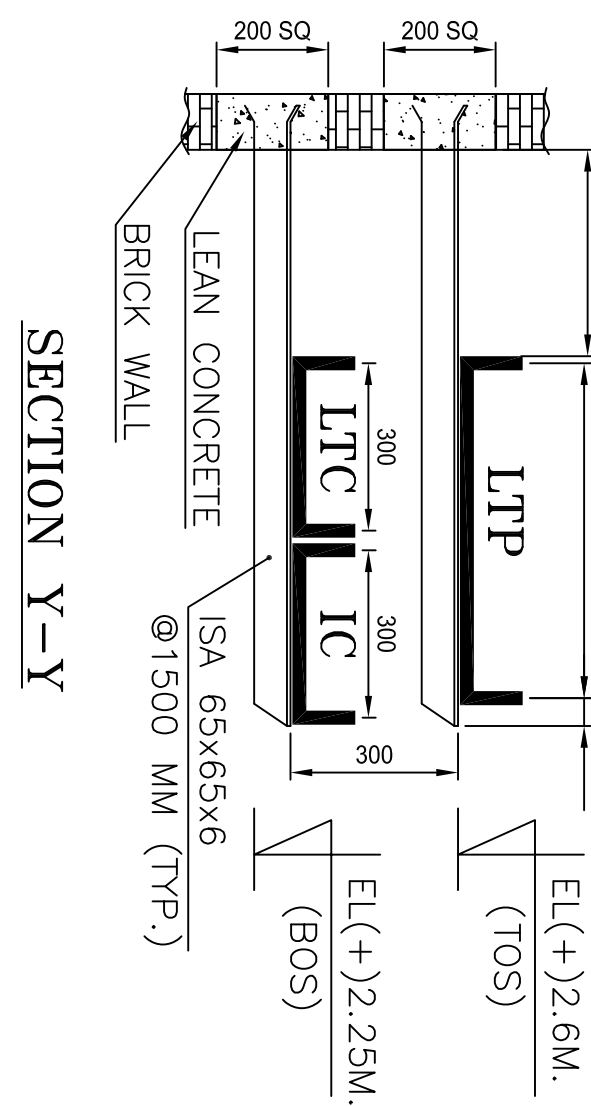
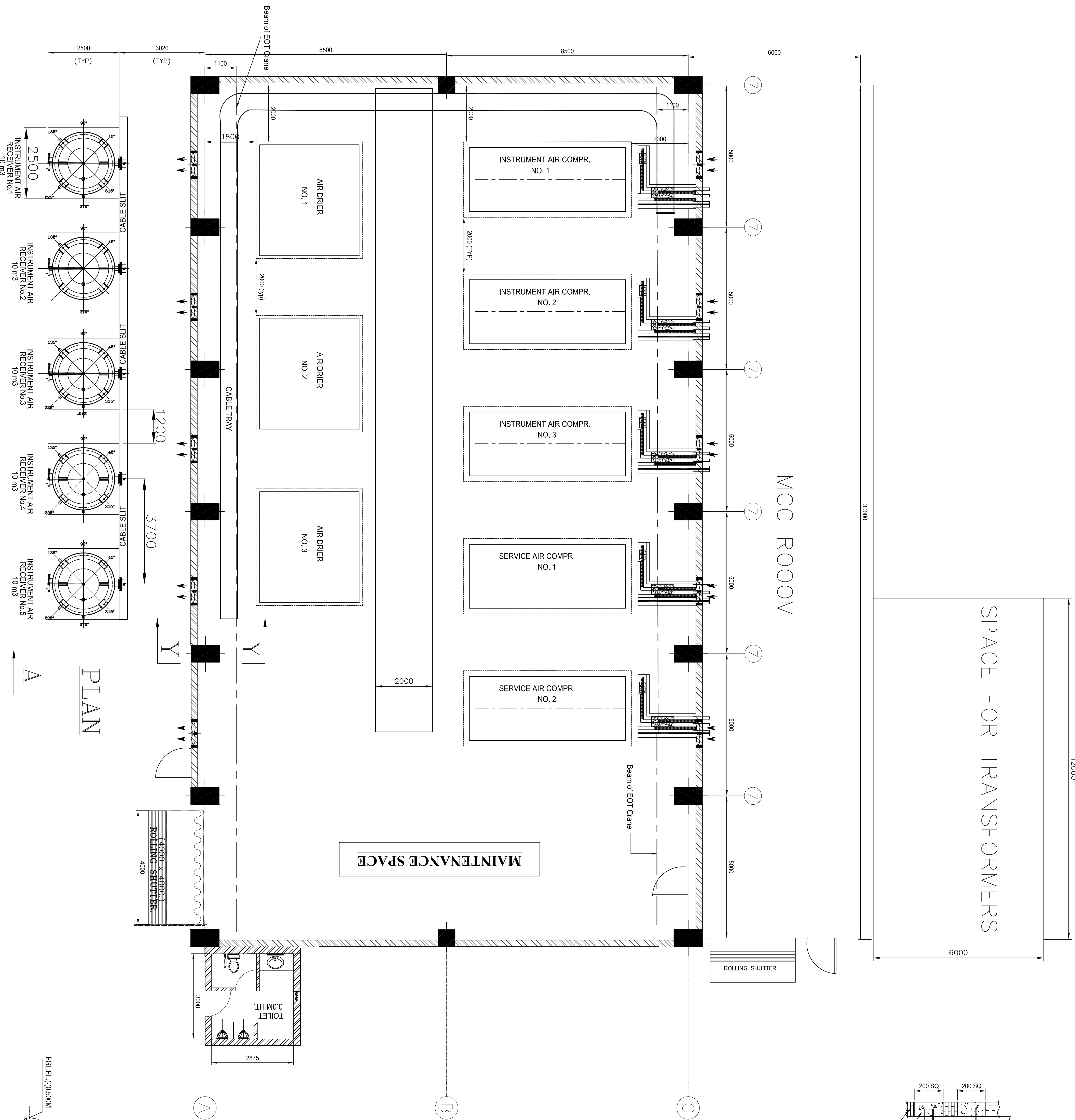
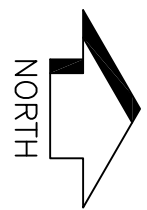
28/06/2018



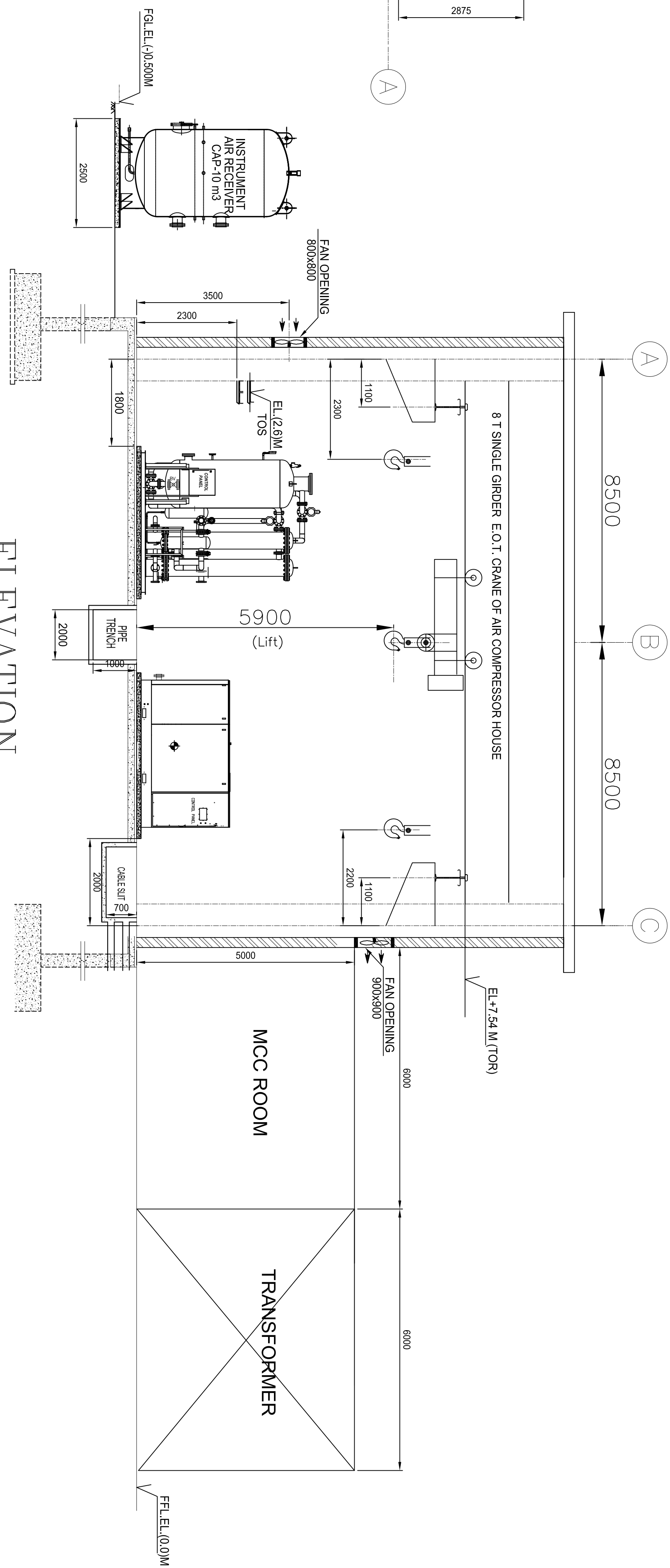
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT: PATRATU SUPER THERMAL POWER STATION EXPANSION
STAGE-I (3x 800MW)

TITLE		SIZE	SCALE	DRG. NO.	REV.
SCHEMATIC DRAWING OF COMPRESSED AIR SYSTEM		A1		9585-001-POM-A-047	A

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	WS	PHNG	M	E	CM	APPD	DATE
A	RELEASED FOR TENDER	TARUN									



ELEVATION
SECTION A-A



COMPUTER FILE NAME:

COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
It must not be used directly or indirectly in any way detrimental to the interest of the company.

CUSTOMER : **NTPC Limited**
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT : **3X800 MW PVUNL PATRATU TPP PHASE-1**

REV	DATE	AUT	CHD	APPD	DEPT	NAME	SIGN	DATE
1	27.02.18				DEPT	NAME	SIGN	DATE
2	27.02.18				DEPT	NAME	SIGN	DATE
3	27.02.18				DEPT	NAME	SIGN	DATE
4	27.02.18				DEPT	NAME	SIGN	DATE
5	27.02.18				DEPT	NAME	SIGN	DATE
6	27.02.18				DEPT	NAME	SIGN	DATE
7	27.02.18				DEPT	NAME	SIGN	DATE
8	27.02.18				DEPT	NAME	SIGN	DATE
9	27.02.18				DEPT	NAME	SIGN	DATE
10	27.02.18				DEPT	NAME	SIGN	DATE

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

COMPRESSION HOUSE LAYOUT

WPL	ELEC	MSE	CIVIL	CKI	DEPT.	SCALE	DRAWING NO.	REV.
						1:6000	PE-DG-434-555-A015	00

3 X 800MW PATRATU STPS

ANNEXURE - IV

(MANDATORY SPARE LIST)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

EPC PACKAGE FOR PATRATU STPS EXPANSION PHASE-I (3x800 MW)

LIST OF MANDATORY SPARES FOR COMPRESSED AIR SYSTEM

SI. NO.	PARTICULARS	QUANTITY	CATEGORY
2.00.00	Compressed Air System:		
2.01.00	Oil free Screw Air Compressor (As applicable)		
2.01.01	H. P. Stage Complete HP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.	1 Set of each type/rating	Cat I
2.01.02	L. P. Stage Complete LP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.	1 Set of each type/rating	Cat I
2.01.04	LP stage Gear and Pinion	1 Set	Cat I
2.01.05	HP stage Gear and Pinion	1 Set	Cat I
2.01.06	Air Intake Filter Element With Gaskets	4 Sets	Cat I
2.01.07	Oil Filter Element With Gaskets & Seals	4 Sets	
2.01.08	Safety Valve Springs and Gaskets for HP stage	1 Set	

2.01.09	Safety Valve Springs and Gaskets for LP stage	1 Set	
2.01.10	Valves (within the compressor house with actuators	2 nos of each type/ratings/ size.	
2.01.11	Oil Pump/Motor		
2.01.11.1	Oil Pump and Motor complete assembly	1 Set	
2.01.11.2	Pump impeller/rotor with shaft	1 Set	
2.01.11.3	Set of bearings	2 Set	
2.01.11.4	Set of Seals	2 Set	
2.01.12	Drain / Moisture Trap	2 Set of each type/size.	
2.01.13	Oil Cooler Gaskets & Seals	2 sets	
2.02.00	Centrifugal Compressor (as applicable)		
2.02.01	Pinion Shaft Journal Bearing Assembly	2 Sets	Cat I
2.02.02	Thrust Bearing Assembly	2 Sets	Cat I
2.02.03	Shaft Seals for Air-Oil (All stages)	2 Sets	Cat I
2.02.04	Gasket / O rings	3 Sets each type/size	
2.02.05	Air Filter Elements	4 Sets each type/size	
2.02.06	Lub Oil System		
2.02.06.1	Main oil pump complete	1 No	Cat I
2.02.06.2	Aux. oil pump complete	1 No	Cat I
2.02.06.3	Complete coupling for Main & Aux. oil pump , spacer	1 No	
2.02.06.4	Cartridge filter elements with gaskets and seals	4 Sets	
2.02.07	Drain / Moisture Trap	2 Set of each type/size.	
2.02.08	Oil Cooler Gaskets & Seals	2 sets	
2.03.00	AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM (As applicable)		
2.03.01	Pre filter element(Ceramic candle or as applicable)	2 sets	
2.03.02	After filter element(Ceramic candle or as applicable)	2 sets	
2.03.03	Heater element(if applicable)	1 sets	
2.03.04	Blower bearing(if applicable)	1 sets	
2.03.05	Blower motor bearing(if applicable)	2 sets	
2.03.06	Valves & Valve Actuators (pneumatic/hydraulic)	2 sets	
2.03.07	Heater coil for temperature stabilization (for HOC type)(as applicable)	2 sets	Cat I
2.05.00	MEASURING INSTRUMENTS		

1	Electronic Transmitters		
(i)	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or 1 No. of each type and model, whichever is more	
2	Temperature elements		
ii)	Thermocouples of each type like K-type, R-type, metal etc. and length *	10% or 2 Nos. of each type and length Which ever is more	
(iii)	Thermowell	10% or 2 Nos. of each type and length Which ever is more	
(iv)	Temperature transmitters	10% or 02 nos whichever is more	Cat I
3	Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make,	
	4 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	10% or 1 No. of each type and model whichever is more	
	5 Dew Point meters	5% or 1 No. of each type and model whichever is more	Cat I
2.06.00	MICROPROCESSOR BASED/PLC BASED CONTROL/ELECTRONIC BASED CONTRAL PANEL (IF APPLICABLE)		
1	Fully programmed controller of electronic modules of each type (as applicable)	10% or 1 no. whichever is more	Cat I
2	Power supply module (if applicable)	10% or 1 no. whichever is more	Cat I
2.07.00	Rotary drum type Air drying plant for Instrument Air system (As applicable)		
	Drive assembly consisting of motor, gear boxes, drive shaft & coupling	1 set	Cat I

Note:

- (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 generally 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, in case it is found applicable during detail engineering.
- f) Any change or variation in equipment or systems during detailed engineering stage which would cause changes / variations in the essential spares, shall be supplied by Bidder without any commercial implications.
- h) Mandatory spares shall not be dispatched before dispatch of corresponding main equipment.
- h) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
- i) The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
- j) Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.
- k) The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.
- l) **Delivery Schedule of Mandatory Spares:**
 - a) **Category I Items - 50 % Items to be supplied one month before scheduled Synchronization of the 1st Unit and Balance one month before scheduled Synchronization of the last Unit**
 - b) **Category II Items -25% of each items to be supplied one month before scheduled Synchronization of U#1 and U#2 respectively and balance 50 % to be supplied one month before scheduled Synchronization of U#3**

3 X 800MW PATRATU STPS

ANNEXURE - V

(DM WATER ANALYSIS)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

CLAUSE NO.	PROJECT INFORMATION			एन टी पी सी NTPC
	ANNEXURE-III			
	THE MINIMUM QUALITY OF DM WATER TO BE CONSIDERED FOR MAKE-UP WATER			
	Sl.No.	Characteristics	Value	
	1.	Silica (Max.)	0.02 ppm as SiO ₂	
	2.	Iron as Fe	Nil	
	3.	Total hardness	Nil	
	4.	pH value	6.8 -7.2	
	5.	Conductivity	Not more than 0.1micro mho/cm excluding the effects of free CO ₂	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02		SUB-SECTION-IB PROJECT INFORMATION
				PAGE 10 OF 15

3 X 800MW PATRATU STPS

ANNEXURE - VI

(CUSTOMER SPECIFICATION OF CAS)



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

CLAUSE NO.	TECHNICAL REQUIREMENTS			
COMPRESSED AIR SYSTEM				
1.00.00	SYSTEM DESCRIPTION			
1.01.00	The compressed air system shall consist of Instrument Air compressors & their motor drives, Air Drying (ADPs) Plants, Service Air compressors & their motor drives, air receivers for each Air compressors, instrumentation and control, control panels, interconnecting compressed air piping in the compressor house, Instrument Air Piping network, service air piping network and Unit Instrument Air receivers (One for each unit).			
1.02.00	The Air compressors & Drives, instruments, control panels and ADPs shall be located indoor inside the compressor house and the air receivers shall be located outside the compressor house. The compressor house shall be provided with an electrically (with pendent control for long travel, cross travel and lifting) operated, overhead traveling type (EOT) crane.			
1.03.00	Unit Air receivers for instrument air system provided to cater the requirements of Instrument air requirement of respective SG (Steam generator) & auxiliaries and TG (Turbine Generator) and its auxiliaries. The Unit Air receivers shall be located in TG building area.			
1.04.00	Further, a dedicated air receiver shall be provided near Demineralising Plant to meet the instrument air requirement of Water Treatment plant.			
1.05.00	Air from Instrument air compressors shall be dried in respective Air Drying Plants in compressor house and delivered to the Air receivers. From the Compressed air piping header at the downstream of Air receivers, one instrument air piping header for each unit of main plant and one for balance of plant shall be provided. Distribution of instrument air network shall be provided as per the tender drawing.			
1.06.00	A separate service air header shall be tapped off from the pipe header at Service Air receiver outlet and distributed as per the tender drawing.			
2.00.00	EQUIPMENT DESCRIPTION:			
2.01.00	The minimum requirements of design and construction features of various components of Compressed air system (screw /Centrifugal type air compressor, air dryer, air receiver, etc.) are described below.			
3.00.00	SCREW AIR COMPRESSORS			
3.01.00	CODES AND STANDARDS			
3.01.01	The design, manufacture, testing and performance of the various components of the Rotary Screw type Air Compressors shall comply with the requirements of relevant codes (IS-5456, IS-10431 [part -1], ASME PTC-9, IS-6206, IS-5727 and CAGI).			
3.01.02	Other International Standards like American/BS/DIN etc. equivalent or superior to above mentioned standards are acceptable. Where IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal.			
3.01.03	The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.			
3.02.00	DESIGN AND CONSTRUCTION			
3.02.01	The compressor shall be oil free multistage, horizontal, water cooled, rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.			
3.02.02	The rotor and shaft shall be of single piece construction, made of forged steel (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron (IS-210 grade) Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2		SUB SECTION-A-16 COMPRESSED AIR SYSTEM
PAGE 1 OF 8				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.03	The seal rings and retainers shall be of stainless steel construction and be free for radial self adjustment along the rotor shafts.			
3.02.04	Bearings shall be high precision antifriction type IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.			
3.02.05	Lubrication system shall be as per manufacturer standard practices			
3.03.00	Gear Box			
3.03.01	Gears shall have a rating of AGMA-12 or equivalent. 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.			
4.00.00	CENTRIFUGAL AIR COMPRESSORS			
4.01.00	CODES AND STANDARDS			
4.01.01	The design, manufacture, testing and performance of air compressors and accessories shall comply with the requirements of one or more of the relevant codes as applicable (IS-2825, IS-4503, CAGI, IS-5727, IS-6206, ASME-PTC-10 and IS-11727).			
4.01.02	International Standards like American/BS/DIN etc. equivalent or superior to above mentioned standards are acceptable. When IS specification is not available the equipment shall conform to one such International Standard, which shall be indicated in the proposal. All codes and standards used/ referred to shall be to their latest edition/ version as on the date of the acceptance of the tender.			
4.01.03	All equipment as may be necessary shall conform to the provision of statutory and other regulations in force, such as Indian Explosive Act, Indian Factories Act, Indian Petroleum Act and also those of State Government.			
4.01.04	All electrical equipment supplied shall comply with the latest revision of Indian Electricity Rules and within the statutory requirement of the Government of India and State Government as regards safety, earthing and provision specified therein for installation and operation of electrical equipment.			
4.02.00	DESIGN AND CONSTRUCTION			
4.02.01	Each compressor unit shall be complete with HT electric motor drive of suitable capacity. Driver rating shall be minimum 110% of compressor rated BKW at rated conditions or BKW at un-throttled minimum ambient temperature whichever is higher.			
4.02.02	Compressor components shall be interchangeable as far as possible.			
4.02.03	Air Compressors shall be oil free centrifugal air compressors with non-contact air/oil seals, each capable of delivering continuously rated volume flows at rated delivery pressure.			
4.02.04	Compressor elements shall be completely removable as independent parts. Materials of construction shall be suitable for the service.			
4.02.05	The rotor shaft shall be of single piece construction, made of Stainless Steel (or equivalent). The stator (casing) shall be of Cast-Iron Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.			
4.02.06	Bearings shall be high precision self aligning tilting pad bearings/ equivalent proven self aligning bearings. The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.			
4.02.07	The gaskets shall be of asbestos free material.			
4.02.08	Lubrication system shall be as per manufacturer standard practices.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 2 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.09	Each compressor shall be provided with Inlet Guide Vane (IGV) control for suction air volume control.			
4.02.10	Each compressor shall be provided with coupling guard with fixing arrangement.			
4.02.11	Proper and robust supporting arrangement shall be provided from foundation/ floor for overhang casing, oil coolers, air piping, cooling water piping, oil piping, etc.			
4.02.12	Compressors shall be provided with adequate safety, protection control system including anti surge protection with bypass valve etc. and auto dual control (either; controlled for constant pressure or constant volume flow). The duty points shall be at least 15% away from the anti surge line.			
4.02.13	The compressors with all accessories shall be designed and tested as per API 672.			
4.03.00	PERFORMANCE REQUIREMENT			
4.03.01	Air Compressors (screw /Centrifugal type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement as specified in the Data Specification Sheet.			
4.03.02	The power rating of the driver shall be selected such that a minimum margin of 10% is available over the power required to deliver rated capacity against rated pressure.			
4.03.03	As more than one 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 in the same room.			
4.03.04	Compressor frame shall have minimum 10% extra capacity. Compressor shall have 25% minimum turndown capability (at 45 deg C & 75% RH). Compressor shall be provided with IGV at the suction flange.			
5.00.00	INTERCOOLER, AFTERCOOLER & OIL COOLERS (FOR SCREW/CENTRIFUGAL)			
5.01.00	Intercoolers, after coolers and Oil coolers shall be of water cooled & shell-and-tube type with water on the tube side. Intercoolers & after coolers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.			
5.02.00	Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from the compressor house outlet header shall be limited to 45 deg.C. However, the instruments or the pneumatic devices requires air temperature less than 45 deg.C., the same shall be achieved at the outlet header.			
5.03.00	Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover.			
5.04.00	Oil Coolers shall be equipped with vent & drain connections on oil and water sides. Oil temperature control valve with manual override feature or bypass construction shall be provided to maintain constant temperature. Vent & drain connections for intercoolers and aftercoolers shall be provided.			
5.05.00	Design pressure shall be 8 Kg/cm2 (g) or based on shut-off head of cooling water pumps.			
5.06.00	The coolers shall be designed for maximum heat load and atleast 10 percent design margin shall be provided in the number of tubes.			
5.07.00	Adequately sized safety valves shall be provided for both intercoolers and after coolers.			
5.08.00	Each intercooler and aftercooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock.			
5.09.00	Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 3 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	trap may be of full bore ball valve operated by capacitance type level switch. Manual draining facility shall also be provided in the drain trap.			
5.10.00	Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C / SA 516 Gr 70 / equivalent).Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminium brass or Copper or SS 304.			
6.00.00	AIR RECEIVERS			
6.01.00	Capacity of each of the air receivers in the compressor house shall be of minimum 10 M ³ (nominal). The capacity of the Unit air receivers shall be minimum 10 M ³ (nominal) or to suit the emergency storage requirement (if any) for any of the Bidder's requirement whichever is higher.			
6.02.00	Receivers (other than unit air receivers) shall be outdoor located and vertical cylindrical vessel with dished ends.			
6.03.00	The design pressure and temperature shall be minimum 10 Kg/cm ² (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.			
6.04.00	Air receivers are to be provided with gasketed inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc.			
6.05.00	Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition & structure as that of material welded. Welding electrodes to be approved by Employer. Electrodes to be dried before use.			
6.06.00	Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be atleast 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.			
6.07.00	Each receiver shall be provided with pressure indicator, temperature indicator and drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves.			
6.08.00	The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent.			
7.00.00	INTAKE AIR FILTER AND SILENCER			
7.01.00	Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type.			
7.02.00	The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning.			
7.03.00	The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.			
8.00.00	AIR DRYING PLANTS			
8.01.00	One number Air drying plant shall be provided for each Instrument air compressor. Drying shall be by adsorption process through a desiccant medium.			
8.02.00	Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR "Heat of (HOC) Compression type".			
8.03.00	Regeneration of desiccant shall be achieved by "open through" or "Heat of compression" method without any air purge loss.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 4 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.04.00	Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant in case of "Heat of compression type ADP" and air from blower shall be used for regeneration after heating by electrical heater in case of "Open through type ADP".			
8.05.00	Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves.			
8.06.00	In "Open Through" type ADP, for regeneration of desiccant, atmospheric air shall be filtered, heated through an electric heater and passed through the desiccant before exhausted to atmosphere. The reactivated desiccant shall be cooled through same atmospheric air without heater in operation. In case of HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying. The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant for both the types of ADP.			
8.07.00	Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers. The filtering media shall be of ceramic candle type elements designed to withstand atleast 50% of static pressure as differential pressure. The pre-filters shall be provided with automatic electrically operated drain trap arrangement with isolation and bypass valves.			
8.08.00	The electric heaters (if required) (2x100% capacity for each ADP) shall be provided with thermostatic control for heater and relief valve for safety and shall be flanged type to facilitate easy replacement of element.			
8.09.00	Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet.			
8.10.00	The adsorber tower shall be designed with sufficient cross sectional area resulting low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels.			
8.11.00	The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for "Intercoolers, After coolers & Oil coolers" above.			
8.12.00	All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with air tight gasketed manholes/handholes and relief valves.			
8.13.00	Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle.			
8.14.00	Adsorption capacity and density to be considered for silica gel shall not be more than 10% and 550 kg/m ³ respectively. In case of activated alumina the same shall be 8% (max) and 900 kg/m ³ (max.) respectively.			
8.15.00	In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 5 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	cycle time and quality of air (dew point) shall be maintained throughout the design cycle period.			
8.16.00	Complete ADP equipments shall preferably be mounted on a skid.			
8.17.00	Required sample connections in piping be provided for sampling of air at desired locations.			
8.18.00	Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided.			
8.19.00	The material of Construction for various components of ADP shall be as as per manufacturer's proven standard.			
8.20.00	HOC dryers of single rotating drum type design using packed desiccant with in-built regeneration and adsorption compartments are also acceptable in place of specified twin-tower type dryers, if the design ensures specified performance guarantee. In case, the Contractor offers such a type, the same shall be of proven design and shall meet the conditions stipulated under "proven-ness criteria" in relevant sub-section of Part-A, of Technical Specification. The control & instrumentation requirements specified is applicable for such design also.			
9.00.00	INTERCONNECTING PIPING, FITTING AND VALVES			
	The interconnecting piping & valves within compressor house for compressed air & cooling water etc shall be designed in line with the specification furnished in subsection titled "Low Pressure Piping" of Part-B of this Technical Specification.			
10.00.00	E.O.T. CRANE			
10.01.00	The crane shall be of electrically operated, pendant controlled, overhead travelling type. The Span and runway length shall suit the compressor house building. The design code for EOT crane shall be IS: 3177 latest edition. The Capacity of the cranes shall not be less than that indicated elsewhere or 25% above the weight of the heaviest items envisaged to be lifted during erection and maintenance work.			
11.00.00	CONTROL PHILOSOPHY			
11.01.00	GENERAL			
11.01.01	The minimum requirements are specified herein and the same shall be elaborated by contractor. The Contractor shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the Employer during post award engineering stage.			
11.01.02	Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.			
11.01.03	On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system.			
11.01.04	All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel.			
11.01.05	An electrically operated automatic valve shall be provided on cooling water supply line of each compressor & dryer (if applicable) which will automatically shut off the cooling water supply, in case any of the compressor/dryer is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor.			
11.01.06	The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 6 OF 8	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(a) Status of each compressor (b) Instrument air pressure low/high (c) Service air pressure low/high (d) Dew point of instrument air (e) Status of each ADP			
11.01.07	Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.			
11.01.08	Unless otherwise mentioned in the relevant electrical sub-section, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.			
11.02.00	Screw /Centrifugal compressor			
11.02.01	Each compressor shall be in the control panel to operate either in Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) mode in case of Screw and unload/module/energy optimization (Auto Dual Mode) in case of centrifugal			
11.02.02	In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve.			
11.02.03	In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.			
11.02.04	The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down.			
11.02.05	The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor:-			
	(a)	"Air temperature high" at inlet to last stage	Alarm & trip	
	(b)	"Low lube oil pressure"	Alarm & trip	
	(c)	"High Lube oil supply temperature"	Alarm & trip	
	(d)	"High oil filter differential pressure"	Alarm	
	(e)	"Low lube oil level in lube oil sump"	Alarm	
	(f)	"High inlet air filter differential pressure"	Alarm & trip	
	(g)	"Low cooling water flow to air compressor"	Alarm	
11.03.00	Air Drying Plant			
11.03.01	Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual take over.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 7 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS		
11.03.02	Change over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.		
11.02.03	The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low cooling water flow", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP". Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same.		
11.02.04	For rotary drum type Air drying plant, control philosophy as per manufacture's standard and proven practice is also acceptable.		
12.00.00	PAINTING All the equipments shall be protected against external corrosion by providing suitable painting. The surface of SS, galvanized steel, Gun metal, Brass, Bronze and non-metallic components shall not be applied with any painting. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per standard procedure. All Painting shall be done as per approved painting scheme of the vendors/Manufacture which shall be submitted by bidder and as approved by Employer.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB SECTION-A-16 COMPRESSED AIR SYSTEM
			PAGE 8 OF 8

3 X 800MW PATRATU STPS

ANNEXURE - VII

(PAINTING SPECIFICATION)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.			
1.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected.Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.			
1.06.05	Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminium paint to IS 2339. PS9* - Heat resistant Aluminium paint to IS-13183 Gr.-1 PS13 - Rust preventive fluid by spray, dip or brush. PS14 - weldable primer-Deoxaluminate or equivalent. PS16 - High Build Epoxy CDC mastic `15' . PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=40.0(min.) PS-20 - Epoxy based finish paint			
1.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.			
1.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.			
1.06.08	SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.			
1.06.09	a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron. The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner: Primer coat – Epoxy based zinc phosphate Intermediate - Epoxy based TiO2 pigmented coat Finish coat - Epoxy based finish coat b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron. c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 2 of 9 28/06/2018

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.10	A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows: Primer : One coat of unmodified epoxy resin along with polyimide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener. Total thickness of primer and paint should not be less than 400 microns.			
	B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 3 of 9 28/06/2018

1.06.11 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painti ng DFT (Micr ons)	Colour Shade
				Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)		
A) Power Cycle Piping														
1.	All insulated Pippings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	As per NTPC Colour shade/ coding scheme
2.	All un-insulated Pippings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature < or equal to 60°C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 \$	35 \$	155 \$	
		Design temperature above 60°C- 200°C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200°C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH) and Variable Load Hanger (VLH)	SP4*	PS19	1	40	-	-	-	PS17	1	30	70		

4	Piping hangers/ supports (other than (3) above. (un-insulated)		SP4 (SP6 - for cleaning of weld joints after erection,)	PS 5	1	40	PS 4	1	40	PS 17	1	40	120
	Valves												
5.	Cast/Forge d	Design temperature < or equal to 60 degC	SP1/SP2/S P3	PS4/P S9	1	40	Polya mide Epoxy	1	100	PS17	1	40	180
		Design temperature above 60 degC and up to 200 degC	SP1/SP2/S P3	PS 9*	1	20	-	-	-	PS9*	1	20	40
		Design temperature above 200 degC	SP1/SP2/S P3	PS9*	1	20	-	-	-	PS9*	1	20	40
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	SP4*	Inorga nic Ethyl Zinc Silicat e	1	75	PS18	1	75	a))Epoxy coat b)Final coat of paint PS17	2 1	35 30	250

		Within building	TG	SP4*	-do-	1	35	PS18	1	35	a)Epoxy coat b)Final coat of paint PS17	2 1	25 30	150	
7.	Weld Edges			SP6 (Hand cleaning by wire brushing)	PS13 (Weld able primer)	1	25	-	-	-	-	-	-	25	
1. \$ The first 2 finished coats (total min. DFT of 70 microns) shall be done at shop and the 3rd finish coat (min. DFT 35 Microns) shall be applied at site. 2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint. 3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable. 4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content > 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme. 5. For corrosion protection for all inner parts of the hangers shall be at least in full compliance to Corrosion category C3 as per EN ISO12944.															
B) Steam Generator & Auxiliaries:															
1	All surfaces with temperature 95°C or less and which are insulated	SP3/SP4	PS 5	2	30	-	-	-	PS 4	2	\$	20	\$	100	\$
2	All surfaces with temperature above 95°C and which are insulated	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1		20		40	

Note: 1) SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

2) For valves below 65NB and temperature upto & including 545 Deg.C, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.

C) LOW PRESSURE PIPING

1	All Pipes, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Colour shade/ coding scheme
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											

D) Fire Detection & Protection System, Compressed air system, Hydrogen generation plant and Air-conditioning & Ventilation System

For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System

For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System.

For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-30, Ventilation System.

For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section-A-16 compressed air system.

For hydrogen generation plant, Surface preparation and painting should be as per the Part-B, Sub-Section-A-19 hydrogen generation plant.

E) ESP

1	All surfaces with surface temperature 95°C or less (with insulation)	SP3/SP4	PS3/ PS5	1	25	-	-	-	PS 4	1	30	55
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2	30	-	-	-	-	-	-	60

General Notes (Applicable for all above points A to E)

- i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	BID DOC. NO. CS-9585-001-2	TECHNICAL SPECIFICATIONS SECTION VI, PART-B	TECHNICAL REQUIREMENTS	SUB-SECTION -A-12 Surface Preparation & Painting	Page 8 of 9
--	----------------------------	--	---------------------------	---	-------------



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

F) FGD System

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

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	BID DOC. NO. CS-9585-001-2	TECHNICAL SPECIFICATIONS SECTION VI, PART-B	TECHNICAL REQUIREMENTS	SUB-SECTION -A-12 Surface Preparation & Painting	Page 9 of 9
--	----------------------------	--	---------------------------	---	-------------

3 X 800MW PATRATU STPS

SECTION-IB

SPECIFIC TECHNICAL REQUIREMENT – ELECTRICAL



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



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
COMPRESSED AIR SYSTEM
3X800 MW PVUNL PATRATU TPP PHASE-1

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION :
REV NO. 00 : DATE : 06.06.2018
SHEET : 1 OF 3

TECHNICAL SPECIFICATION

FOR

COMPRESSED AIR SYSTEM
(ELECTRICAL PORTION)

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800 MW PVUNL PATRATU TPP PHASE-1	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 06.06.2018
		SHEET : 2 OF 3

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 **COMPRESSED AIR SYSTEM**.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

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

बीएचईएल 	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR COMPRESSED AIR SYSTEM 3X800 MW PVUNL PATRATU TPP PHASE-1	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 06.06.2018
		SHEET : 3 OF 3

compliance certificate/No deviation certificate.

- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor
- b) BHEL cable listing format (Annexure -VIII)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGES : COMPRESSED AIR SYSTEM****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: 3X800 MW PATRATU STPS EXPENSION PH-1**

<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 ph 4 wire)/240 V AC (supply feeder) shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the 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: 3X800 MW PATRATU STPS EXPENSION PH-1**

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 in 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.

Annexure -VIII

[illegible]