Gujarat State Electricity Corporation Limited (GSECL)

1x800 MW GSECL,Wanakbori TPP, Unit No. 8.

VOLUME – II B & III

TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM

SPECIFICATION NO.: PE-TS-408-555-A001, Rev 0

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA

VOLUME – IIB

VOLUME-III

SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, proper packing and shipment and delivery at site, as required on FOR site basis, supervision of erection and commissioning, final painting & carrying out acceptance tests at site of compressed air system of as per details in different sections / volumes of this specification and various pre award agreements for **1X800 MW GSECL WANAKBORI TPS.**

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 Lube oil pumps within quoted price.

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 highest 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. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

1.5 The general term and conditions, instructions to tenderers 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.

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 along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/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, Section - C shall prevail over section – D, however 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 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please referred relevant clause(s) of GCC.

SECTION: B

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

CONTENT

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Supercritical Thermal Power Project would be set up by Gujarat State Electricity Corporation Limited (GSECL) at Kheda district of Gujarat.

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

2.00.00 APPROACH TO SITE

The proposed site is located in Kheda district about 13 kilometers from the nearest commercial town of Balasinor & 10 kilometers from Sevalia town. The National Highway, NH-08, connecting Dakor – Godhra is about 10 kilometers from the site. The State Highway SH – 59 connecting Balasinor – Sevalia is about 2 Kilometers from the site. Nearest railway station to the existing site is Sevalia, located about 8 kilometers from the site on Anand – Godhara main broad gauge line of Western Railway.

Nearby Air Ports are Ahmedabad at a distance of about 110 kilometers from the site and Vadodara at a distance of about 85 kilometers from the site.

3.00.00 LAND

The proposed extension unit will be developed in the existing Wanakbori Thermal Power Station and will be located north east side of the existing plot in the Kheda District of Gujarat. The land of the proposed plant will be filled in upto a desired level. Existing Ash Pond/ Dyke area will be utilized for the extension unit.

4.00.00 SOURCE OF COAL

Indian coal would be sourced from captive mines Machha Kata in Talcher, State – Orissa which are situated about 1800 Kms from the project site. GSECL will arrange for transportation of the coal required for the extension unit from these captive mines by the existing railway facilities for delivery of coal supply to the Wanakbori power station.

5.00.00 SOURCE OF WATER

The water required for the new unit shall be obtained from River Mahi, flowing by the side of the existing Wanakbori Power Station.

One (1) new jackwell will be installed on Mahi river for supply of water for new plant. In addition, existing Canal Water and Jackwell Water will have interconnection with new plant to cater plant water requirement of new plant.

6.00.00 ASH DISPOSAL AREA

Existing Ash Pond / Dyke area will be utilized for the extension unit. Fly ash silos will be located outside plant boundary wall (but within GSECL land) in the vicinity of the Ash Dyke area.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	72 M
Max. daily average temp	:	34 ºC
Min. daily average temp	:	11.7 ºC
Max. Ambient air temp. (daily)	:	34ºC
Max. Ambient air temp. (yearly)	:	30ºC
Max. Ambient air temp.	:	42ºC
Wet bulb temperature	:	28ºC
Relative Humidity	:	RH varies within a range from 50% to 95%.
Average annual rainfall	:	750 mm

[Metrological data of Vadodara is attached for reference].

SEISMIC ZONE

Zone III as defined in Kheda District profile Booklet 2006-07

SECTION: C

TECHNICAL SPECIFICATIONS

VOLUME - II B

SECTION: C1A

SCOPE OF SUPPLY,TERMINAL POINTS AND EXCLUSIONS

1. SCOPE OF SUPPLY AND SERVICES:

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

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

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

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

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

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

1.1.5 Eight (8) Nos. Air Receivers of minimum fifteen (16) Cu.M capacity each with instruments, relief valve, drain connection with automatic trap stations and other accessories as specified.

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

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

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

1.1.9 All airline valves & cooling water valves – 1 Lot.

1.1.10 Necessary instruments for control and interlocks [instruments indicated in the P&I Diagram for the compressed air system with refrigerant type air drier (refer volume-III section -8) to be considered as a minimum].

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

1.1.12 HT motors for the air compressors.

1.1.13 Common Hot Redundant PLC based control system is provided for the overall controls of the 6 Compressors (3 IA Compressor + 3 SA Compressor), 3 nos.of air driers, and other instruments pertaining to the compressed air system. The necessary instrumentation and control shall be provided for safe and trouble free operation of compressed air system. For detailed description on operations / interlocks, PLC configuration, UPS configuration etc. specific C&I requirements shall be referred.

1.1.14 Group Control is envisaged to clock more or less equal number of running hours for each set of Instrument Air Compressor & Service 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. The required panel for the same shall be housed in the PLC control room adjacent to the compressor house.

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

1.1.16 Any other item not indicated above, but required to complete Compressed Air package as per system requirements.

1. TERMINAL POINTS :

1.1 Bidder will terminate compressed air piping for common IA header and common SA header downstream of air receiver as per enclosed tender drawing no PE-DG-408-555-SK001 (Pl. refer section 8, Vol.-III).

1.2 Cooling water supply will be provided by the purchaser outside the compressor house as per enclosed tender drawing no PE-DG-408-555-SK001. The return hot water shall be terminated by the contractor at the same location (Pl. refer section 8, Vol.-III).

2. EXCLUSIONS :

2.1 MCC/Switchgear for power supply to Air Compressors and other drives and panels.

2.2 Civil works like construction of compressor house, foundation of all compressor, air dryer and air receiver, pipe/cable trenches. However, civil works such as opening in wall, grouting of equipment's & structural material and inserts plates for pipes supports etc. are in the bidder's scope of supply.

2.3 Lighting and ventilation of compressor house.

2.4 Monorail hoists/Cranes as necessary for handling of equipment after erection.

2.5 UPS, Battery and Battery charger for the PLC and the OWS/OEWS (However the electrical load for the UPS shall be mentioned in the electrical load data (refer Volume-III, Section-5) and submitted along with the bid.

3. SUB-VENDOR ITEMS

The make of Sub-vendor items shall be generally as per Annexure-I, Vol.-III enclosed which is subject to customer approval during detail engineering.

4. DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The drawings and documents to be submitted with the bid shall strictly be as mentioned under Volume III (section-1). Any documents other than those indicated in Volume III (section-1) will not be reviewed and will not form part of contract.

5. DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

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

6. DRAWINGS DISTRIBUTION SCHEDULE

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

7. DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

1) Plot plan (Pl. refer section 8, Vol.-III)

2) P&I Diagram for compressed air system with Refrigerant type air drier (Pl. refer section 8,Vol.-III).

3) Compressor House layout (Pl. refer section 8,Vol.-III).

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

8. Mandatory Spares

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

9. OTHER REQUIREMENTS

- Detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 2 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- The O&M Manual to be submitted by the successful bidder will necessarily address the following:
    a. Complete System Description along with PIDs, write up on electrical philosophy and safety/process interlocks etc.
    b. Instructions for plant operation
    c. Commissioning procedure of the system
    d. Chapter on precautions to be taken during:
        - Operation
        - Idle time
        - Long shutdown
    e. Chapter on trouble shooting during plant operation covering:
        - Safely aspects
        - Do's and do not's
        - Maintenance schedule
        - Schedule of lubricants & consumables
    f. O & M instruction for all individual equipment which shall invariably contain but not necessarily limited to the following:
        - Equipment description/interdiction
        - Data sheet, Equipment GA & Cross Section Drawing
        - Catalogue of each equipment
        - DO's & DON'T's
        - Duty Conditions
        - Installation & Safety Recommendation
        - Start-up & shut down procedure
        - Instructions for testing and adjustment of system parameters
        - Disassembly & Assembly Instructions giving sequence no. of each component
        - List of Replacement/ Spare parts along with their drawing and catalogues and procedure for ordering spares.
        - Reason & Remedy Chart for any problem
        - Maintenance Schedules- Daily, Weekly, Monthly, Half Yearly and Annual indicating clearly the spares part and man-hour requirement for each stage.
        - Detailed specification/ Schedule of all the consumables including lubricant oils, greases, chemicals etc. required for the complete system
        - Commission procedure for equipment.
- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- In case vendor submits revised drawing/doc after approval of the corresponding drawing/doc, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.
- Bidder to note that during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per dwg/ document distribution schedule. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end

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

    DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
    For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

- Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule and along with the bid. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
- Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".
- If any deviation is there then same to be indicated separately under the heading "Schedule of Technical Deviation" enclosed as per Volume III (SECTION 4) of the Technical Specification along with Cost of Withdrawal and the same shall be made part of the price-bid to be submitted by the bidder. 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.

10. Bidder to note the following information :

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

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

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

11. ADDITIONAL POINTS TO BE NOTED BY BIDDER

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

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

11.1.3 All drawings and documents shall be computer based.

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

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

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

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

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

11.1.9 Compressor and air dryer shall be designed for cooling water (passivated DM water) with inlet temp of thermal 38 deg C (max.) & mechanical 60 deg C with terminal pressure 5-7 kg/sqcm (g) and The max temp of hot water from compressor shall be 6 deg. C higher cooling water inlet temp. Further the temperature of the air at the outlet of after cooler shall be 6 deg.C above cooling water temperature. The Compressors and dryers coolers shall be designed to withstand 12 kg/cm2 i.e., shutoff head of BHEL DM cooling water pumps. The pressure drop across the individual equipment's within the compressor shall be maintained at 6 to 8 MWC. However, the pressure drop across the complete cooling water circuit shall be 10 MWC. Successful bidder shall furnish break-up of pressure drop for individual components and compressors as a whole in the datasheet to be submitted for approval at the time of detail engineering.

1.1.1 Bidder to note that the cooling water pipe size shall be decided considering cooling water requirement for Compressed air system & additional cooling water requirement of 25

M3/hr. for MRS compressors. Also, bidder to provide 200 NB isolation valves (globe type) both for cooling water supply & cooling water return line. Further, bidder to note that terminal point for these tapping shall be provided 5 m from compressor house at end closer to pipe rack/pedestal.

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

1.1.3 Access platform required for the maintenance of instruments/valves on the towers of HOC type air drier shall be in bidder's scope of work.

1.1.4 Only KKS tagging shall be used in all document/drawings and in the field for all items/equipment/signals etc. No other tagging method is acceptable. The successful bidder shall provide detailed drawing with KKS only. Operational write up of the system should strictly contain KKS code for identification and description. For KKS tagging philosophy please refer Volume IIB (SECTION C-4)

VOLUME - II B

SECTION: C1B

SPECIFIC TECHNICAL REQUIREMENT

GENERAL DESCRIPTION

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

1. DESIGN CRITERIA

1.1 SYSTEM DESIGN CRITERIA

Compressed air system includes the following:

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

Instrument and service air compressors shall be skid mounted, two stage rotary screw air compressor.

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

Intake air filters.

Eight (8) nos. air receiver of 16 M3 capacity, i.e., one no. for each compressor near compressor house.

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

Controls & interlocks.

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

1.2 EQUIPMENT DESIGN CRITERIA

AIR COMPRESSORS

The capacity of instrument air compressor shall be 30 NM^3/min (Refer Compressor capacity calculation in Annexure-II). Delivery pressure will be 8.5 Kg/cm^2 (g) at outlet of IA compressor & 8.0 Kg/cm^2 (g) at ADP outlet. Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.

The capacity of Plant Air Compressor shall be 30 NM^3/min. Delivery pressure will be 8.5 Kg/cm^2 (g) at outlet of SA compressor.

Each air compressors skid shall include lubricating arrangement with lube oil pumps and coolers as per manufacturer's standard.

The compressors' capacity will be designed for 42^0 C DBT and 95% RH at atmospheric pressure at site & at MSL of 72.0m.

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

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

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

Noise level shall not exceed 85 dB under free field condition when measured at a distance of 1.0 meter above the floor. The discharge blow off silencer and intake silencers shall be designed to meet the above noise limitation level. A background correction factor of +/- 8 dBA shall be applicable while testing of compressors at site/manufacturer's works.

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

The motor rating (at the design ambient temperature specified for the electric drive in K9213R-EPC-SPC-001_V2F1-SEC-02 of the contract specification, refer Section C-3 Volume-IIB) shall be at least 110% of the power required at design condition of compressors (HT Motors) and shall not be less than the power required at any other ambient conditions.

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

Further LT Motors used (if any) in the compressed air system shall be at least 115 % of the power required at the design condition.

Compressor and air dryer shall be designed for cooling water from DMCW system. Quantity of cooling water for cooling of air compressors & air dryers shall be limited to 210 m3/hr. (max.) for all working drives. Pressure drop across the cooling water circuit shall be limited to 10 MWC (however, the pressure drop across the individual component's within the compressor shall be maintained at 8 MWC max.). The max temp of hot water from compressor shall be 6 deg. C higher cooling water inlet temp. Further the temperature of the air at the outlet of after cooler shall be 6 deg.C above cooling water temperature. Accordingly the coolers for air compressors and driers shall designed taking the above factors into consideration.

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

i) Compressor chamber: Cast iron coated with corrosion resistant material.

ii) Rotors: Forged carbon steel coated with corrosion resistant material

iii) Timing Gear: Low, Alloy Steel.

iv) Inlet throttle valve & Housing: Aluminium

v) Shaft / shaft seals: High alloy steel / Stainless Steel.

vi) Safety valves: Brass

vii) Water separator: Cast Iron

viii) Non-return valves: Stainless steel spring loaded type.

ix) Blow off valve: Stainless steel.

x) Unloading Cylinder header: Aluminium

xi) Tube of Blow off cooler / oil cooler: SS / Cupro-Nickel / Copper

xii) Outer casing of coolers: Carbon Steel

xiii) Gear box: Cast Iron GGG 40 (DIN 1693)

xiv) Gears: Alloy Steel.

xv) Bearing: Anti Friction (as per manufacturing standard)

xvi) Base Plate: MS

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

INTAKE FILTER

Heavy duty dry type suction air filters will be provided at the compressor inlet to prevent dust and dirt from entering the cylinders. The filtering efficiency shall be 99.9% up to particle size of 1 micron. Sound suppressing characteristics will be considered in the filter design. Max. pr. drop across filer at design flow rate in new condition shall be limited to 150mmWC.

AIR DRYING PLANT

Air-drying plant shall be of Refrigerant type. Capacity of each ADP shall be 33 NM^3/min (i.e. 1.1 times the rated capacity of instrument air compressor).

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

a) Dew point at outlet of the air drying plant will be minus **(-) 20^0 C** at atmospheric pressure.

b) The quality of air at the outlet of air drier shall be class – 1 as per ISO 8573.

c) Oil content 0.01 ppm (maximum tolerable) or oil free and maximum dust particle size 1 micron.

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

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

Each air drying plant shall be complete with the following accessories:

1. Air Inlet Strainer
2. Pre-Cooler
3. Evaporator
4. Compressor
5. Water Cooled Cooled Condenser
6. Throttle Valve

AIR RECEIVER

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

Design Pressure for the air receiver shall be 10.0 kg/cm^2 (g) and 50 deg C respectively. The hydraulic test pressure shall be 15 Kg/cm2 (g).

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

The material of construction of shell, dished ends, flanges etc. of the air receivers shall be as per IS-2002/SA 516 Gr70. The corrosion allowance shall be 2.5 mm.

The air receiver drain connection shall be provided with automatic drain valve for automatic removal of drain consisting of valve, strainer, double isolation & bypass

valve. The set pressure of the relief valve shall be atleast 10% above the working pressure.

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

PIPING, FITTINGS & VALVES (WITHIN COMPRESSOR HOUSE)

PIPING and FITTING

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

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

Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60 deg. C.

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

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

VALVES

a) Compressed Air Services:

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

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

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

Trim / Disc. : ASTM-A-182 F304 for Gate, Globe, Check valves and

351CF 8M for Ball valves.

Seating surface: For Ball valves PTFE seats and seals.

b) Water Service:

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

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

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

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

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

Auto drain trap for each air receiver shall be provided.

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

2. LAYOUT CONSIDERATIONS

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

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

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

A tentative General arrangement drawing for the Compressor House is being attached herewith this document (Annexure-III)

All piping of compressor shall be routed in such a way that a clear head room space of minimum 2 meter shall be available along the walkway between compressor & Drier system.

3. OPERATION, CONTROL & INSTRUMENTATION

PLC based control system is provided for the overall controls of the 6 Compressors (3 IA Compressor + 3 SA Compressor). The PLC shall be located in the compressor control room in the compressor house. The necessary instrumentation and control has been provided for safe and trouble free operation of compressed air system. Salient features of the control system in brief are furnished as under.

One (1) no. Microprocessor based control panel in built with each IA and SA compressors as well as for each Air Drying Plant provided shall be as per manufacturer's standard.

Overall control of compressed air system shall be through PLC with one no. OWS and 1 no. EWS both consisting of 24" LCD monitor shall be provided along with A3 size coloured laser printers. For the PLC configuration diagram for the compressed air system please refer Section C-4, Volume-IIB.

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

d) Local Mode: Individual compressor is operated from Local Integral Control System.

e) Remote Mode: Individual compressor is operated through PLC OEWS.

f) During remote mode, individual compressor & air dryer Start-Stop command shall be executed from OES through Central PLC based panel.

g) The general status of the individual compressor shall be available at the OEWS through the 'hard wired'/'soft link' connection (depending upon the manufacturer's product standard).

h) All individual compressor and drier local panels shall be hardwired interfaced with common PLC panel. Required hardwire/soft link interface between PLC and DCS shall be provided for remote, monitoring, alarm and selective operation as required. Hardwired Start/Stop of compressors from DCS shall be provided.

The control system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention. Group Control is envisaged to clock more or less equal number of running hours for each set of Instrument Air Compressor & Service 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. The required panel for the same shall be housed in the PLC control room adjacent to the compressor house.

Redundant soft-link connectivity between DCS and PLC shall be provided.

Ergonomically & aesthetically designed furniture viz. control desks & chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161(Please refer Section C-4, Volume-IIB).

UPS Power supply for OWS, OEWS & PLC shall be provided from Main Plant UPS.

4. POWER SUPPLY ARRANGEMENT

The power supply (rated voltage, frequency, phase) of the equipment's will be 3.3 KV/ 415 V +/- 10%, 3ph,4 wire 50 Hz +5% to -5%.

5. SITE DEMONSTRATION TESTS

Please refer section-C2C, Volume II-B(Functional/Performance demonstration/Guarantee tests.

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

6. MANDATORY SPARES

Please refer Annexure-II Section-E shall be submitted separately.

SECTION: C-2

CUSTOMER SPECIFICATIONS

SECTION: C-2A

TECHNICAL REQUIREMENT

CONTENTS

SECTION-2

TECHNICAL SPECIFICATION FOR COMPRESSED AIR SYSTEM

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification is intended to cover the Design, Engineering, Manufacture, Fabrication, Assembly, Inspection, Testing at Manufacture's works, Packing, Transportation, Delivery, Receipt, Unloading, Storage and handling at site, supervision of Erection, Testing, Commissioning and Field Acceptance/ Performance Guarantee test of compressed air plant consisting of air compressors, receivers and air drier units with all associated accessories and auxiliaries as specified herein after and as required for safe trouble free operation and maintenance for 1X800 MW Supercritical Power Project, Unit No. 8 at Wanakbori TPS, Gujarat.

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

1.03.00 Compressed Air is mainly required in the following areas :

i) Turbine Generator (TG) and Auxiliaries.

ii) Steam Generator (TG) and Auxiliaries.

iii) Water Treatment area.

iv) Various pump house area

v) Coal Handling Plant

vi) Laboratory

vii) Plant I & C area

2.00.00 GENERAL INFORMATION

2.01.01 The compressed air plant (Compressors and Air Dryers) shall be located in Air Compressor and DG Building. The air receivers shall be located outdoor. All equipments, electricals, instruments to be supplied under this specification shall be suitable for their respective location. For details of electrical equipment relevant sections of the Electrical Specification shall be referred.

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

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

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

2.01.05 All the piping works including all accessories.

3.00.00 SYSTEM DESCRIPTION

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

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

3.03.00 Three (3) Nos. of Air drying plants (two working and one standby) of Refrigerant type non-cycle version with continuous and fully automatic operation shall be provided to ensure dry moisture free Instrument quality air. The schematic arrangement of Compressed Air System has been shown in Drawing No.: K9213R-DWG-M-001S.

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

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

4.00.00 CODES AND STANDARDS

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

4.01.01 IS-2825/1969 : Code for unfired pressure vessels.

4.01.02 IS-4503/1967 : Shell and Tube Type Heat Exchanger

4.01.03	IS-5456/1985	:	Code of Practice for testing of positive displacement type air compressors and exhausters.
4.01.04	IS-5727/1981	:	Glossary of terms relating to compressors and exhausters.
4.01.05	IS-1239 Part-1/1990	:	Mild Steel tubes, tubulars and other wrought steel pipes.
	IS-1239 Part-2/1992	:	Mild steel tubes, tubulars and other wrought steel fittings.
4.01.06	IS-6206/1985	:	Guide for selection, installation and maintenance of air compressors/plants with operating pressure up to 10 bars.
4.01.07	ANSI-B16.5 (1988)	:	Steel Pipes Flanges and Fittings.
4.01.08	IS-7938/1976	:	Air Receivers for Compressed Air Installations.
4.01.09	IS-10431 Part-I/1983	:	Measurement of Air Flow of Compressor and Exhausters by nozzles.
4.01.10	ASME PTC-9	:	Performance Test Codes for Displacement Compressors, Vacuum Pumps and Blowers.
4.01.11	BS-5169/1975	:	Fusion Welded Steel Air Receiver.
4.01.12	IS-11989	:	Specification air dryer.
4.01.13	ISO-7183	:	Compressed Air Dryers - Specification and Testing
	ISO-7183 (Part-II)	:	Compressed Air Dryers - Performance rating
4.01.14	API 619	:	Rotary Type Positive Displacement Compressors

4.02.00 In case of any contradiction with the aforesaid standards and the stipulations as per this Section and Attachments/Annexures of this section, the stipulations of this Section and its Annexures shall prevail. In case of any contradiction between this Section and Attachments/Annexures, stipulations of Attachments/Annexures shall prevail.

5.00.00 SPECIFIC DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS

5.01.00 The Compressed Air System shall ensure a reliable supply of adequate quantity and quality of oil free dry air on continuous and intermittent basis for the 1x800 MW Unit. It consists of two sub systems namely,

a) Instrument Air (IA) for Instrumentation and Control purposes for the station.

b) Service Air (SA) for some boiler equipment, general house cleaning and other miscellaneous usage.

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

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

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

Z = (A+B+C+D+E+F) x [1+ (mw+ml)/100] Where,

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

A = Instrument Air requirement for SG & auxiliaries.

B = Instrument Air requirement for TG & auxiliaries.

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

D = Instrument Air requirement for Ash Handling Plant.

E = Instrument Air requirement for Laboratory.

F = Plant C&I requirement.

mw = Wear & tear margin = 10%

ml = Leakage margin = 10%

The free air delivery capacity of each Instrument Air Compressor shall be equal to the one-half of the value Z as obtained or 25 NM^3/Min., whichever is higher.

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

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

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

G = Service Air requirement for SG & auxiliaries.

H = Service Air requirement for TG & auxiliaries.

J = Service Air requirement for Coal Handling Plant.

K = Service Air requirement for Ash handling Plant.

L = Service Air requirement for Various Pump Houses.

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

mw = Wear & tear margin = 10%

ml = Leakage margin = 10%

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

5.04.00 Compressed air system shall comprise of one (1) IA group and one (1) SA group of compressors. The capacity of each air compressor shall be as per clause No. 5.03.00.

5.05.00 IA group shall consist of 3x50% (i.e Two (2) working and one (1) standby) compressors with necessary intercoolers, after coolers, piping, valves, instruments and other accessories with built-in control panel and supplemented by 3x50% Air Drying plant. There shall be one (1) Air Receiver for each IA compressor.

5.06.00 SA group shall consist of 3x50% (i.e Two (2) working and one (1) standby) compressors for each unit with necessary intercoolers, after coolers, piping, valves, instruments and other accessories with built-in control panel. There shall be one (1) Air Receiver for each SA compressor.

5.07.00 Suitable interconnections shall be kept between SA and IA headers before Air Dryers for each unit with normally closed motorized isolation valves and non-return valve connected in such a way to allow only service air in instrument air header in case of emergency.

5.08.00 Equipment operating on Instrument Air and Service Air System shall be designed for a pressure range of 5.5 Kg/cm^2 (g) to 120% of rated discharge pressure of each air compressor, as computed in accordance with clause no. 5.02.00 above.

5.09.00 The delivered compressed air shall not contain any trace of oil, grease or any other impurities. Size of particles in the delivered air shall not exceed 1 Microns.

5.10.00 Compressed air system equipment requiring DMCCW cooling water shall be

capable of operation at design capacity with cooling water inlet temperature subject to a maximum of 36°C in DMCCW system. The above equipment shall also be capable to withstand a pressure not less than the shut off head of each DMCCW pump.

5.11.00 The temperature of air at outlet from after cooler shall not exceed 6°C above the cooling water inlet temperature.

5.12.00 Air Compressors shall be identical and shall be designed for continuous operation with high efficiency to satisfy the performance requirements as specified in Annexure-A enclosed with this section.

5.13.00 The power rating of the driver shall be selected such that a minimum margin as per the specification of electric motors, is available over the power required to deliver rated capacity against rated discharge pressure. When the driver is not directly coupled to the compressor, due account should be made for losses in power transmission, in addition to the above margin.

5.14.00 As more than one (1) compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, Keeping noise level within permissible limits for a number of compressors working simultaneously.

5.15.00 Each Air Receiver shall be so sized that even in the event of total stoppage of air inflow to the same, the pressure in the Air Receiver shall not fall below 6.5 kg/cm^2 absolute within two (2) minutes of such stoppage, while maintaining an out flow of air at a rate equal to the rated capacity of a single compressor, during the aforesaid period. In no case, the size of each Air Receiver shall be less than that arrived from IS 7938.

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

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

V_{AR} = Volume of each Air Receiver in M^3.

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

P_A = Atmospheric pressure, shall be taken as 1 Kg/Sq.cm (absolute).

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

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

C = Free air delivery capacity of each Air compressor for IA system or free air delivery capacity of each SA compressor for SA system, M^3.

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

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

5.16.00 The drying capacity of each Air Drying Plant (ADP) shall be provided to match the corresponding capacity of each IA compressor.

5.17.00 The air drying plants receiving compressed air saturated with moisture shall be capable of operating continuously to provide reliable moisture free compressed air. Dew point of the outlet air measured at the stated operating pressure shall be as mentioned in Annexure-B or lower throughout the operation. For calculating moisture load, relative humidity and dry bulb temperature at ADP inlet shall be taken as 95% & 34°C respectively.

5.18.00 The drying process shall employ Refrigerant type air drying unit to remove moisture from air. The air drying plant shall be considered to remove the moisture and dry air to following quality:

a) Dew point at atmospheric pressure (-) 20 degree.

b) Oil content 0.01 ppm (maximum tolerable) or oil free.

c) Dust – Practically dust free but maximum particle size 1 micron.

Air quality after air drying plant shall be in accordance with above stipulations or as per ISA – S7.3 (Instrument society of America) quality standards for instrument air, whichever is stringent.

5.19.00 Driers shall be suitable for part load operation while maintaining the outlet air dew point as specified above. Necessary instruments and controls shall be provided to ensure that the specified dew point is maintained irrespective of input variations.

5.20.00 The contractor shall assume full responsibility in the operation of the air drying plant as a whole.

5.21.00 For the air drying capacity and all other relevant details pertaining to Air Drying Plant, Annexure-B shall be referred to.

6.00.00 SCOPE OF SUPPLY AND WORKS

6.01.00 Scope of Supply

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

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

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

6.01.02 One (1) no. Microprocessor based control panel in built with each IA and SA compressors as well as for each Air Drying Plant shall be provided. Each built-in control system for the compressors & air dryers shall be complete with necessary Hardware and Software, push buttons, annunciations as needed to make the system completely reliable and efficient.

Additional PLC/Microprocessor based control panel for common control of instrument air and service air compressors. This panel shall be interfaced with DCS for monitoring.

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

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

a) Air inlet strainer.

b) Air to air heat exchanger (pre-cooler).

c) Air to refrigerant heat exchanger (evaporator).

d) One (1) moisture separator with auto drain trap.

e) Refrigerant condensing unit complete with one (1) hermitically sealed compressor, one (1) compressor drive motor, one (1) water cooled condenser, refrigerant circuit access connection, refrigerant distributor, high and low pressure cut-out switches, interconnecting pipes, valves, fittings as required, liquid and suction line, one (1) filter dryer, one (1) sight glass with moisture indicator, safety valves or any other pressure relief devices.

f) One (1) automatic expansion valve in refrigerant line.

g) All inter-connecting/integral piping, valves trap stations with by-pass valves at drains, fittings, flanges, gaskets, etc.

h) Instrument and controls.

i) Interconnecting wiring.

j) One (1) dew point indicator.

6.01.05 Supporting structures, base plates, support plates, foundation/ anchor bolts, nuts, sleeves, inserts, lifting lugs, eye bolts, etc. as needed for efficient installation and handling of equipment.

6.01.06 All interconnecting piping, instrument air and service air distribution piping, valves, supports and hangers, drains, instruments etc. as indicated in the tender drawing nos. K9213R-DWG-M-001S, K9213R-DWG-M-001L and K9213R-DWG-M-001M.

7.00.00 **DESIGN AND CONSTRUCTION**

7.01.00 The Compressors shall be designed to deliver the nominal capacity at the required delivery pressure as mentioned in Annexure-A of this section.

7.02.00 The design shall be such as to ensure trouble free operation with least vibration and noise. Suitable acoustical treatment will be provided to ensure the noise level within permissible limits as specified in Vol-IIA. Different parts of the compressor and accessories shall be arranged neatly in a compact manner. Due consideration shall be given for easy accessibility and maintenance of the compressors.

7.03.00 The compressors shall be non lubricated, oil free, horizontal, multi-stage water cooled, electric motor driven screw type, heavy duty and rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.

7.04.00 Unless inconsistent with this section, equipment from the standard range of manufacture of the Bidder shall be preferred.

7.05.00 Compressor components shall be interchangeable as far as possible. Material of construction shall be suitable for the service.

7.06.00 Design capacity, outlet pressure and the material of construction for various parts of the compressor and accessories shall be as specified in Annexure-A enclosed with this section.

7.07.00 **Compressor casing, rotor and shaft**

7.07.01 Compression chamber wall thickness shall be such that to withstand maximum design pressure.

7.07.02 During maintenance of compressor suitable arrangement for cleaning of the cooling water jackets shall be provided.

7.07.03 Dynamically balanced, one-piece Rotor construction with a symmetric profile to keep leakage loss to a minimum and ensure high efficiency.

7.07.04 Rotor shaft mounted, highly precise timing gears shall be designed to counter the axial forces incurred in compression.

7.07.05 The rotor and shaft shall be of single piece construction, made of forged steel with suitable corrosion resistant coated material to minimize leakage and wear (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron Construction with corrosion resistant material and with integral jacket cooling.

7.07.06 The shaft sealing and retainers shall be free for radial self-adjustment on the rotor shafts.

7.07.07 The seal rings and retainers shall be of stainless steel construction. The seals shall prevent air and oil leakage along the shaft. Air vented from second stage discharge end seals shall provide buffer air to the other seals to prevent migration of oil towards the compression chamber under all operating conditions.

7.07.08 The gaskets shall be of asbestos free material.

7.07.09 Use of Oil lubricated anti friction type bearings to be at least 8000 running hours.

7.08.00 **Lubrication System**

7.08.01 The compressor package shall include a lubricant management system which shall lubricate the bearings and seal. By the design, the compressor chamber (screw rotor housing) is totally separated from bearing / gear chamber.

7.08.02 The lubricant pump shall be shaft driven. An auxiliary motor driven pump shall be provided if required by the manufacturer to supply pre-start and shut down system. All lube oil pumps shall be of rotary positive displacement type, having stainless steel rotors and steel casing. The pump discharge system will be protected by a relief valve.

7.08.03 The heat exchanger for lube oil cooler shall be water cooled. The heat exchanger shall be located within the enclosed compressor skid.

7.08.04 The fouling factor shall be considered as per the recommendation of TEMA.

7.08.05 The lube oil cooler shall be designed for a heat duty corresponding to the peak power demand of the compressors.

7.08.06 The cooler shall be designed in accordance with the requirement of IS-2825.

7.08.07 Due consideration for the differential expansion of shell and tube shall be given in the design of the coolers.

7.09.00 **Gear Box**

7.09.01 Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position. Gears shall have a rating of AGMA-12 or equivalent.

7.10.00 **Inter Cooler, After Cooler and Moisture Separator**

7.10.01 Inter-cooler shall be located between the low and high-pressure stages, if required, to reduce overall power consumption. Design performance shall be in accordance with Manufacturer's Standard and wall thickness of tubes and expansion joints shall ensure maximum trouble-free service for long period.

7.10.02 Design of intercooler and after cooler shall be such as to keep the Cooling Water pressure drop within limits and complete leak tight condition for long period of service time.

7.10.03 After-cooler at each compressor discharge shall be water cooled and supplied by the Bidder. It shall be located after compressor discharge to bring the outlet temperature of the compressed air within 6°C, of the cooling water inlet temperature. The moisture separator to be provided on after cooler air outlet shall have suitable internal baffling for removal of moisture and oil. Necessary safety valves shall be provided on inter coolers and after coolers.

7.10.04 Inter-cooler, After-cooler and Moisture Separator shall be provided with Auto trap stations including strainer, bypass and double isolating valves for the traps. A level gauge glass with isolating cock shall be provided near the bottom of moisture separator. Automatic traps shall be of reputed make and shall be of float type suitable for intended services. Y-strainer of 20 mesh screen of stainless steel shall be placed before each trap.

7.10.05 The water cooled after coolers and intercoolers shall be shell and tube type. The intercooler shall have air in shell side and water in tube side to add surge volume for reducing air pulsation before the second stage.

7.10.06 The shell, tubes, tube sheets and expansion joints with tube sheets particularly at flange portion etc. of the heat exchangers shall be designed to withstand the maximum working pressures encountered. Necessary allowance for corrosion shall be provided.

7.10.07 The tubenest shall be removable type to facilitate cleaning and maintenance.

7.10.08 Intercoolers/After coolers shall be provided with supports, which are designed to avoid undue stress or deflection in support or body of the equipment.

7.10.09 Due consideration for the differential expansion of shell and tube shall be given in the design of coolers.

7.10.10 Necessary drain and vent nozzles shall be provided for intercooler and after cooler.

7.11.00 **Air Receiver**

7.11.01 Air receiver(s) shall be in accordance with IS-2825 or ASME Sections-VIII Div.I and IS-7938.

7.11.02 The design pressure, capacity and other parameters shall be as specified in Annexure-A of this section.

7.11.03 The air receiver shall be vertical self-supporting cylindrical vessel with torispherical dished ends and with supporting stand for resting on the Civil foundation in accordance with Annexure-A enclosed with this section.

7.11.04 Receivers shall be of welded construction with minimum number of joints. Longitudinal seams in adjacent sections of shell shall not be in the same line.

7.11.05 All welding shall be performed in accordance with relevant codes. Filler material that will deposit weld metal with a composition and structure as near as that of the material being welded shall be used. The electrodes shall be dried in oven immediately before use to ensure freedom from porosity.

7.11.06 Receivers shall be provided with required number of nozzles, the orientations of which shall be subject to approval by the Purchaser. At least two gasketed inspection holes shall be provided for receivers up to 600 mm diameter. For larger diameter manhole of minimum 450 mm diameter shall be provided.

All openings shall be placed as far as possible from welded seams and in no instance shall pierce the seam.

7.11.07 Receivers shall be provided with one or more safety relief valves of proper capacity so that the maximum working pressure of the system is not exceeded under any circumstance. Unless otherwise mentioned, each receiver shall be provided with at least one pressure gauge and one temperature gauge of proper range and required number of pressure switches for compressor control purposes.

7.11.08 Each air receiver drain connection shall be provided with automatic no air loss type drain valve for automatic removal of drain consisting of valve, strainer, double isolation and bypass valves.

Each Air Receiver should have air release vents at the top to facilitate statutory hydraulic tests as per IS-7938.

7.11.09 Receiver shall be heat-treated in accordance with BS-5169.

7.12.00 **Intake Air Filter and Silencer**

7.12.01 Filters with multiple elements and quick removal type for easy cleaning to be provided at suction of each air compressor and shall also be of heavy-duty dry type. Oil bath type shall not be acceptable for non-lubricated compressors.

7.12.02 The filters shall be complete with integral silencers and all other accessories. The filtering elements shall be easily removable for cleaning or for replacement.

7.12.03 The filters shall be designed for an efficiency of not less than 95% for particles 1 microns and larger.

7.12.04 The silencer shall be of very high efficiency type to adequately dampen the operating noise as per the requirements in Volume-IIA.

7.12.05 Pulsation dampener of approved design shall be provided on the compressor suction and discharge manifold.

7.12.06 If filter after receiver is specified in Attachments/Annexures, the same shall be provided to remove the bulk of moisture and other contaminants entrained in the air stream.

7.13.00 **Drive Unit**

7.13.01 The compressors shall be driven by constant speed squirrel cage induction motor unless otherwise specified in Annexure-A of this section. For determining the output rating of driver, general guidelines as indicated in Cl. no. 5.13.00 of this section and Volume : II-F/1 & II-F/2 of this specification shall be followed.

7.13.02 The driver shall be connected to the compressor either directly or through gear box as per Annexure-A of this section.

7.13.03 For other types of connection between drive unit and compressor, suitable flexible coupling shall be provided.

7.13.04 Necessary guard shall cover all exposed moving parts.

7.13.05 Motor speed torque curve shall match with that of the compressor for trouble free start up.

7.13.06 Motor shall be capable for three (3) equally spreaded starts per hour. Two start in quick succession from cold condition and one restart from hot condition.

7.14.00 **Moisture Separator**

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

7.15.00 **Air Dryer, Precooler, Evaporator and Refrigerant condenser**

7.15.01 Air-drying plant shall be of Refrigerant type.

7.15.02 Air dryer shall be located Indoor.

7.15.03 Complete ADP equipments shall be preferably mounted on a skid.

7.15.04 Precooler, Evaporator and Refrigerant condenser shall be of shell and tube type construction.

7.15.05 Precooler shall use dry air and wet air as shell and tube side fluids respectively.

7.15.06 Evaporator shall use refrigerant as shell side fluid and air as tube side fluid media.

7.15.07 Refrigerant condenser shall be water cooled with refrigerant as shell side and cooling water as tube side fluid.

7.15.08 Design shall conform to TEMA (USA) – Class-C.

7.15.09 Heat Exchanger elements like shell, tube and tube sheet shall be adequately designed to withstand the design pressure.

7.15.10 Drain and vent nozzles and safety valves, as necessary, shall be provided for the precooler, evaporator and refrigerant condenser.

7.16.00 **Refrigerant Compressor**

7.16.01 The compressor for the refrigerated type air dryer shall be hermetically sealed, reciprocating, medium speed, single acting type designed with ecofriendly refrigerant R-134A or equivalent.

7.16.02 The reciprocating compressor shall be complete with cylinder liner, pistons, crank shaft, connecting rod, bearings, suction and discharge valves, crank case heater, proper lubrication system etc. (as applicable).

7.16.03 The compressor shall be complete with all parts and accessories commended by the manufacturer to run it efficiently and satisfactorily.

7.16.04 The safety devices against high pressure of refrigerant, low pressure of refrigerant shall be provided.

7.16.05 The horse power for the compressor motor shall be sized with margin as per specification of electric motors over maximum rated power required for the unit including the drive loss.

7.16.06 The compressor assembly shall be adequately designed for minimum vibration and noise disturbances.

7.16.07 Expansion valve shall be of thermostatic type.

7.16.08 All the components of the Air Drying plant including the strainers, filter, interconnecting piping, valves, fittings, control panels, etc. shall be mounted on a common fabricated steel base frame to form a self contained unit.

7.17.00 **Pressure Vessels**

7.17.01 All pressure vessels shall be designed as per IS : 2825 or approved equal.

7.17.02 The vessels shall be of self supporting construction. All welding materials and procedures shall be as per IS: 2825 or approved equal.

7.17.03 Each vessel shall be provided with suitable air-tight manhole and other connections as required.

7.17.04 Relief valves of adequate capacity shall be provided for each vessel. Relief valves shall be provided with hand lever. The valves shall be of stainless steel construction.

7.17.05 Internal surfaces of all the vessels shall be suitably protected against corrosion and rusting. Corrosion allowance of 2.5 mm shall also be provided on shell and dished end thickness.

7.17.06 Draining trap station complete with Auto drain trap, isolation and by-pass valves and Y-strainer shall be provided for the moisture separator.

7.18.00 **Solenoid Valves and Multiway Valves**

7.18.01 The solenoid valve shall be of approved make. The solenoid valves shall have heavy duty, double impregnated tropicalised coils (Single or double solenoid as required) and shall be suitable for the operating temperature and for operation continuously energised, in a tropical climate.

7.18.02 The solenoid valves shall be of bronze body with stainless steel trim. The coil shall be of continuous duty and of epoxy moulded type, Class-F. The enclosure shall conform to NEMA-4X standard.

7.19.00 **Drives and Mounting**

7.19.01 All relevant details pertaining to drives shall generally comply with the stipulations laid in Volume : II-F/1 & II-F/2.

7.19.02 All the components of the Air Drying plant including the strainers, filter, interconnecting piping, valves, fittings, control panels, etc. shall be mounted on a common fabricated steel base frame to form a self contained unit.

7.20.00 **Interconnecting Piping, Valves and Fittings**

7.20.01 Pipelines shall be selected as per IS-6206/equivalent standard. Piping in airlines and cooling water lines up to 40 NB shall be socket welded and 50 NB and above shall be butt-welded and flanged type.

All interconnected air piping and cooling water piping etc., as indicated in tender drawings shall be furnished by the Contractor, complete with valves, fittings, pipe supports as necessary. The piping shall be as per the Codes/ Standards specified in Annexure-A enclosed with this section.

7.20.02 The air discharge piping shall be full size of compressor outlet or larger, short and direct with minimum number of fittings. Only long radius elbows shall be used where bends are unavoidable. The velocity of compressed air in pipe shall be limited as per pipe size 50 NB below 20 to 30 m/sec. & 50 NB above 25 to 40 m/sec.

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

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

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

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

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

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

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

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

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

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

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

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

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

7.21.00 **Dew Point Indicator**

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

a) Range : (-) 30 °C to (+) 20 °C

b) Accuracy : ± 0.1 °C

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

7.22.00 **Automatic Drain Valve**

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

8.00.00 **INSTRUMENTATION & CONTROL**

Refer to VOLUME II-E.

9.00.00 **INSPECTION AND TESTING**

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

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

9.03.00 Hydrostatic testing of compressor, intercoolers, aftercoolers, moisture separators, air receivers, strainers, filters, all interconnecting air and water piping with valves and all other applicable pressure parts that could not be spelt out in this clause. Hydrostatic testing shall be carried out at 150% of the design pressure for at least one (1) hour, unless contradicted by the relevant test code.

9.04.00 Specific tests to be carried out for each compressor

9.04.01 Non-destructive testing of rotors, rotor shaft and all other applicable parts.

9.04.02 Type test/Routine tests for all the air compressors as per IS-5456. All performance tests for compressors shall be carried out with actual motor being furnished. Routine tests shall include the following tests and measurements :

a) Capacity (Free Air delivery)

b) Speed

c) Specific power consumption

d) Volumetric and overall efficiency of machine

e) Test of loading and unloading mechanism

f) Any other test deemed necessary for the system

9.04.03 Dynamic balancing of all rotating components and assembly of each air compressor including all drive motors in the compressed air system.

9.04.04 Tests for capacity, pressure drop and efficiency of each Intake Air Filter with silencer shall be as Manufacturer's standard. These tests shall be conducted along with performance testing of each compressor.

9.05.00 Dew Point tests to be carried out on each Air Drying Plant.

9.06.00 Spot radiography of all weld parts shall be tested for all pressure parts and vessels.

9.07.00 Testing of all drive motors and control panels in the compressed air system shall be as outlined under Volume II-F/1 & II-F/2 of this specification.

9.08.00 Any other test deemed necessary for the system.

10.00.00 PERFORMANCE GUARANTEES

10.01.00 Performance Guarantee

10.01.01 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. All compressor units and accessories shall be guaranteed to operate without pulsation, noise or vibration while operating in isolation as well as in parallel with other compressor.

10.01.02 All compressor unit and accessories shall be guaranteed for capacity, pressure and power consumption for specified capacity and pressure either in isolation or during parallel operation.

10.01.03 Drying plant capacity shall be guaranteed for the dew point of minus (-) 20 Deg. C at atm pressure at the dryer outlet as specified in data specification sheet.

10.02.00 Deficient Performance

10.02.01 Performance test and guarantee test shall be carried out in line with the stipulations laid down in data sheets for compressed air system and all defects shall be satisfactorily rectified without affecting overall time schedule of the project. No extra cost shall be charged to the owner for such rectification. After rectification, retesting shall be done by the contractor without any extra cost to the owner till satisfactory performance is achieved.

11.00.00 **DRAWINGS/DOCUMENTS, DATA & INFORMATION TO BE FURNISHED BY THE BIDDER ALONG WITH THE TECHNICAL OFFER**

11.01.00 The Bidder shall furnish along with his proposal following specific drawings/ documents/data as asked for in this section.

11.01.01 P&I Diagram.

11.01.02 Preliminary Layout drawing.

11.01.03 Calculations establishing the rated pressure, FAD capacity of compressors and characteristic curves showing efficiency against capacity, capacity of Air Receivers and ADPs.

12.00.00 **DRAWINGS/DOCUMENT, DATA, AND MANUALS TO BE FURNISHED AFTER AWARD OF CONTRACT**

12.01.00 Final version of all drawings/data/informations asked for in clause 10.00.00 above.

12.02.00 Certified dimensioned general arrangement drawing; detailed cross-sectional drawing with parts list and details of material; piping layout drawings for Compressed Air System.

12.03.00 Foundation drawings with dead load, operating load and other design data.

12.04.00 Functional logic diagram showing operational philosophy, inter lock and protection for the compressed air system.

12.05.00 Complete design calculations for heat exchangers, moisture separator, air receiver, etc.

12.06.00 Local panel layout and complete electrical schematic drawings for instrumentation and control.

12.07.00 Detailed list of Instruments showing make, size, range, tag nos. etc.

12.08.00 Bill of material indicating tag nos., type, sizes, working pressure, material of construction, quantity etc. of the following :

a) Pipe

b) Valves and

c) Fittings

12.09.00 Detailed test reports, certified performance curves as required for all the applicable equipment in Compressed Air System.

12.10.00 Quality assurance plan, datasheet, flow diagram and final layout drawing.

ANNEXURE-A

SCREW TYPE AIR COMPRESSOR AND AUXILIARIES

A. **Performance Data**

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

B. **Construction Features**

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

Type of Annunciation	:	Audio-visual
Flange standard	:	ANSI B-16.5/equivalent

C. **Materials of Construction**

Compressor chamber	:	Cast iron coated with corrosion resistant material
Rotors	:	Forged carbon steel coated with corrosion resistant material
Bearing	:	As per manufacturing standard. (Antifriction Bearing)
Timing Gear	:	Low alloy steel
Base Plate	:	MS
Inlet throttle valve & housing	:	Aluminium
Shaft seals	:	High Alloy Steel
Safety valves	:	Brass
Water separator	:	Cast Iron
Blow off valve	:	Stainless Steel
Unloading Cylinder header	:	Aluminium
Tube of oil cooler	:	SS-304
Outer casing of coolers	:	Carbon Steel
Gear Box	:	Cast Iron GGG 40 (DIN 1693)
Gears	:	Alloy Steel

D. **Supply of Accessories and Service**

Intake air filters with silencers	:	Yes
Intercoolers	:	Yes
Aftercoolers with moisture separators	:	Yes
All instruments as specified, as shown in tender drawing and as required for safe and trouble-free operation of the system	:	Yes

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

E. **DM Cooling Water Data**

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

F. **Testing And Inspection**

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

Field performance test	:	Yes
MPI and UT tests	:	Yes
Spot Radiography for all circumferential and longitudinal butt joints	:	Yes
All other specific tests as specified in Clause No. 9.00.00 of this section	:	Yes

G. **Drive Motor**

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

H. **Compressor Accessories**

a) **Intake Air Filter**

Numbers required	:	One (1) no. with each compressor
Location	:	Indoor/At the suction of each air compressor
Type	:	Dry type
Silencer	:	Yes
Air flow rate	:	To suit compressor rating
Particle removing efficiency	:	99.9% up to particle size of 1 Micron
Maximum allowable pressure drop at stated air flow rate in new condition of filter (viscosity of air at normal ambient temperature)	:	150 mm WG
Test requirement	:	No separate test. Compressor performance testing will include the filters in test set up. Capacity, pressure drop and efficiency shall be measured.

b) **Air Receiver**

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

Installation	:	Outdoor
Type	:	Vertical cylindrical with torispherical dished ends.
Design pressure	:	10 Kg/Sq.cm(g)
Hydraulic test Pressure	:	15 Kg/Sq cm(g)
Design code	:	IS-2825/IS-7938/ Approved equal
Capacity of each air receiver	:	Bidder to compute in accordance with clause no. 5.15.00 of this section. However the water filled volume shall not be less than 10 M^3 under any circumstances.
Material of construction of shell	:	IS-2002
Material of construction of dished ends	:	IS-2002
Material of construction of flanges	:	IS-2002
Supply of Accessories & Services	:	
Flanges with nuts, bolts and gaskets	:	Yes
Pressure gauge with snubber	:	Yes
Pressure switch	:	Yes
Temperature indicator	:	Yes
Relief valve	:	Yes, set pressure shall be atleast 10% above working pressure.
Trap station	:	Yes
Level gauge	:	Yes
Vent valve/plug	:	Yes
Supporting stand with necessary foundation bolts, nuts, sleeves, etc	:	Yes
Eye bolts, lifting tackle etc.	:	Yes

Painting

i)	External	:	Two coats of red-oxide primer and two finish coats of synthetic enamel paints.
ii)	Internal	:	Shop painted as per manufacturer's standard.

Inspection and Testing

Material testing and identification	:	Yes
Bend test as per BS-5169	:	Yes
Spot radiography of circumferential and longitudinal butt welds	:	Yes
Field performance test	:	Yes
D.P. test where radiography cannot be done	:	Yes
Hydraulic Test	:	Yes
Other specific tests as specified in Clause No. 9.00.00 of this specification	:	Yes

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

i) Aftercooler :

Installation	:	Indoor
Type	:	Shell and Tube
Relief Valve	:	Yes
Moisture Separator	:	Yes
Trap Station	:	Yes
Temperature Indicator	:	Yes
Temperature Switch	:	Yes

	Level Gauge	:	Yes
ii)	Intercooler :		
	Installation	:	Indoor
	Type	:	Shell and Tube
	Relief Valve	:	Yes
	Trap Station	:	Yes
	Pressure Gauge	:	Yes
	Temperature Indicator	:	Yes
	Temperature Switch	:	Yes
	Moisture Separator	:	Yes
iii)	Supply of Accessories and Services	:	
	Supporting stands with bolts, nuts and gaskets	:	Yes
	Eye bolts, lifting tackle etc with tools and tackle	:	Yes
	Flanged connections for supply and return of cooling water	:	Yes
iv)	Material of Construction :		
	Tube	:	Stainless steel with in star profile
	Shell	:	Mild Steel
	Tube Sheet	:	IS 2002 Gr 2A
	Baffles	:	IS 2062
	Flanges	:	IS 2062
v)	Cooling Water Data	:	Same as mentioned earlier
vi)	Piping, Valves and Fittings for Compressed Air System :		

	Pipes for cooling water line	:	IS-1239 (Heavy grade) upto 150 NB. IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm.
	Pipes for compressed air line & interconnecting air line	:	Stainless steel as per ASTM-A312 GR.304. Size – as per schedule 40S. ANSI-B36.19 up to 50 mm NB and as per schedule 10S. ANSI – B36.19 for sizes equal to & greater than 65 mm NB.
	Fittings		
	Fittings for cooling water line	:	ASTM A-234 Gr. WPB for sizing including 65 mm NB and above. ASTM A105 for sizes upto 50 mm NB.
	Fittings for compressed air piping & interconnecting air piping	:	Stainless steel as per ASTM A-182 F304
	Valves for air line	:	Stainless Steel
	Valves for cooling water line	:	Carbon Steel
vii)	Testing and inspection	:	As per clause No. 9.00.00 of this section.

ANNEXURE-B

AIR DRYING PLANT AND AUXILIARIES

A. **General Information**

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

B. **Performance Specification**

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

C. **Technical Particulars**

a) Pre-cooler

i)	Type	:	Shell and tube type (Fixed tube bundle type).
ii)	Shell side fluid media	:	Dry Air
iii)	Tube side fluid media	:	Wet Air
iv)	Design pressure	:	Bidder to indicate
v)	Code of construction	:	TEMA-Class-C

b) Evaporator

i)	Type	:	Shell and tube type (Fixed tube bundle type).
ii)	Shell side fluid media	:	Refrigerant
iii)	Tube side fluid media	:	Air
iv)	Design pressure	:	Bidder to indicate
v)	Code of construction	:	TEMA-Class-C

c) Refrigerant condenser

i)	Type	:	Shell and tube type (Fixed tube bundle type).
ii)	Shell side fluid media	:	Refrigerant
iii)	Tube side fluid media	:	Passivated DM Cooling water
iv)	Design pressure	:	Bidder to indicate
v)	Code of construction	:	TEMA-Class-C

d) Refrigerant Compressor

i)	Type	:	Hermetically sealed, Reciprocating
ii)	RPM	:	1500
iii)	No. of cylinders	:	Bidder to indicate

iv)	Type of coupling	:	By Bidder
v)	Refrigerant	:	R-134 A
vi)	Design standard	:	API-618
vii)	Testing standard	:	IS-5111

D. **Materials Of Construction**

Precooler, evaporator, refrigerant condenser

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

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

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

F. **Testing And Inspection**

Non destructive material test	:	Yes
Performance tests at shop and site	:	Yes
Spot Radiography of welds parts to be tested	:	All pressure parts and vessels
Dye Penetration test	:	Yes
Hydrostatic Test	:	Yes
Other Specific Tests	:	As per clause No. 9.00.00 of this section.

G. **Miscellaneous**

Air flow variations	:	0 to 100%
Auto drain trap	:	No air loss type

SECTION: C2-B

PROJECT SPECIFIC GENERAL REQUIREMENTS

1X800 MW WANAKBORI TPS

TECHNICAL SPECIFICATION

FOR

COMPRESSED AIR SYSTEM

VOLUME-IIB

SECTION C 2- B

(GENERAL TECHNICAL REQUIREMENT)

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

CONTENT

VOLUME : IIA

SECTION-IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 All latest codes & standards shall be considered upto the base date. The base date to be considered for codes and standards is fifteen (15) days prior to opening of price bid.

1.06.00 Successful Bidder to furnish two (2) sets of latest International Codes and Standards which have been used for their plants, equipments and system. IS Codes, ASME codes, ASTM codes need not to be furnished. However, International Performance Test Codes shall be furnished as applicable.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.

2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00 Bidder shall comply with the requirements of CPCB and MOEF along with specification requirements whichever is stringent.

2.05.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.06.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 NAME PLATES (RATING PLATES)

3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.

4.00.00 **SAFETY AND SECURITY**

4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

a) The minimum width of clear access corridors around equipment shall be one (1) meter.

b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.

c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of two (2) meters shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

f) All rail/road crossings for pipe/cable racks shall be done with minimum 7 meters clear headroom. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.

g) Cubicle for operating personnel shall be located at safe place near the equipment.

h) All underground cables in the plant shall be placed in covered reinforced concrete cable trenches. Pipes shall in general be routed above ground and on pedestals, and at road crossings, pipe racks shall be provided. Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

i) Concept of various mechanical and electrical equipment location and building dimensions as shown in Plot Plan/Floor Plan drawing are to be adhered to.

However, size of buildings & facilities as stated above, shall be finalized by EPC Contractor considering the basic design criteria of layout as indicated in the specification.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 LUBRICATION

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 LUBRICANTS AND CONTROL FLUIDS

10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of respective units.

10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 OPERATION AND MAINTENANCE

11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 PLANT LIFE AND MODE OF OPERATION

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>50 hrs. shutdown)	:	20 per year
Warm start-up (between 10 to 50 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	180 per year

13.00.00 PACKAGING & MARKING

All the equipment 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 limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 PAINTING

15.01.00 General

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C.

The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

15.02.00 **Preparation**

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

15.03.00 **Damaged Paintwork**

Any damaged paintwork shall be made good as follows :

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.

b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.

c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

15.04.00 **Painting Systems**

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

a) Surfaces Subject To Weathering

All surfaces shall have a minimum of four coats of paint made up as follows :

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT

Finishing coat (2 Nos.) : 35 micron DFT per coat

The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat : 35 micron DFT

Tie coat : 35 micron DFT

Finishing coat (2 Nos.) : 25 micron DFT per coat

The total minimum DFT shall be 120 micron.

The type and colour of primer & finish coat shall be selected by the Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

16.00.00 COLOUR CO-ORDINATION & FINISH

16.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

16.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

16.04.00 Final colours and finishes shall be to the Approval of the Engineer.

17.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

17.01.01 For Liquid Effluent

a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.

b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

17.01.02 For Air Emission

a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm^3 (with worst coal and one field out).

b) NO_x - 365 ppm Max. or 750 mg/Nm^3 (Equivalent NO_2).

c) SO_2 - Concentration based standard 2000 mg/Nm^3 Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

NO_x and SO_2 limitations are based on the World Bank Norms.

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

17.02.00 **Noise Level Requirement**

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

18.00.00 INSPECTION AND TESTING

18.01.00 Inspection and Tests during Manufacture

18.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

18.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

18.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

18.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

18.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

18.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.

18.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

18.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

18.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

18.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.

18.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

18.02.00 **Performance Tests at Site**

18.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

18.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

18.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

18.03.00 For details of specific tests required on individual equipment refers to respective section of this specification.

19.00.00 **TRAINING OF OWNER'S PERSONNEL**

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

19.01.00 **Training at Contractor's Premises**

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	60 heads	60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

2. Plant operation and systems training for operators including simulator training as applicable.

3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

19.02.00 **Operation and Maintenance Training at Site**

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

a) One (1) for Steam Generator and Auxiliaries ;

b) One (1) for Turbine Generator and Auxiliaries ;

c) One (1) for Electrical Works ;

d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;

e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

19.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

20.00.00 **DEVIATIONS**

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission (IEC) Publications.

t) Power Test Code for Steam Turbines (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Emission regulation of Central Pollution Control Board (CPCB).

gg) Pollution Control regulations of Dept. of Environment, Govt. of India

hh) Central Board of Irrigation and Power (CBIP) Publications.

ii) The Air Prevention and Control of Pollution Act.

jj) The Environmental Protection Act

kk) The Public Liability Insurance Act.

ll) The Forest Conservation Act

mm) The Wildlife protection Act.

nn) The EIA Notification, 1994.

oo) IS: 14665-Specification for Electric Traction Lift

pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II

SCHEDULE OF PERMITS & CLEARANCES

Sl. No.	Clearances	Authority	Responsibility
1.0	**STATUTORY CLEARANCES**		
1.1	Pollution clearance, water and air [Sec.25 of the Water (Prevention & Control of Pollution) Act, 1974 as amended in 1988, and Sec. 21 of the Air (Prevention & Control of Pollution) Act, 1981 as amended in 1987]	Gujarat State Pollution Control Board	Owner-Consent to establish the project. Contractor - Permission for operation
1.2	Environmental clearance	Ministry of Environment & Forest, Government of India	Owner
1.3	Aviation Clearance	Airport Authority of India, New Delhi.	Owner
2.0	**NON-STATUTORY CLEARANCES**		
2.1	Land availability at Plant area	Govt. of Gujarat / Private land Owner, if any	Owner
2.2	Land for Transportation of Coal	Govt. of Gujarat / Private Land Owner, if any	Owner
2.3	Transportation of Fuel (Secondary Fuel)	Department of Petroleum and Natural Gas, Ministry of Railways, Shipping and Surface Transport	Owner
2.4	Rights & right to access of all public roads from manufacturer's works to site,	Concerned Authorities	Contractor
3.0	**OTHER CLEARANCES/ APPROVALS**		
3.1	Approval and Registration of steam generator as per Indian Boiler Regulation	Chief Inspectorate of Boilers	Contractor
3.2	Approval as per Indian Electricity Act and Rules for Electrical Installation	Electrical Inspectorate	Contractor
3.3	Approval as per Indian Petroleum Act and Petroleum Rules for storage of petroleum products.	Chief Controller of Explosives	Contractor
3.4	Approval as per gas cylinder rules and handling and transport of compressed gases	Chief Controller of Explosives	Contractor
3.5	a) Collection, storage and disposal of waste during construction till handing over of the project.	Gujarat State Pollution Control Board	Contractor

Sl. No.	Clearances	Authority	Responsibility
	b) Site clearances, safe report and safety audit during construction till handing over of the project.	Gujarat State Pollution Control Board	Contractor
3.6	Approval of Fire Protection Scheme	Authorised Agencies approved by Insurance Regulatory Development Authority, New Delhi (IRDA)	Contractor
3.7	Consent for use of the site for the construction and operation of the Power Station and Fuel Facility	Directorate of Town and Planning of Government of Gujarat	Owner
3.8	Consent for the development of Project Site and the Township site	Directorate of Town and Planning of Government of Gujarat	Owner
3.9	Approval of the proposed design and construction of power station	Chief Inspector of Factories of Government of Gujarat	Contractor
3.10	Allocation / approval of electric supply for bulk construction power	Gujarat State Electricity Dept.	Owner
3.11	Carriage entrance to property	Municipal Corporation: Assistant Engineer, Roads or concerned authorities	Contractor
3.12	Approval of building layout with fire safety concerns and receipt of No Objection Certificate	Municipal Corporation: Chief Fire Officer or concerned authorities	Contractor
3.13	No Objection Certificate regarding air & fugitive emissions	Municipal Corporation: Executive Engineer and Gujarat Pollution Control Board	Contractor
3.14	No objection Certificate for Chimney and Registration	Inspector of Smoke Nuisance	Contractor
3.15	No Objection Certificate for sewage water treatment and associated plumbing	Municipal Corporation: Executive Engineer, Sewerage and Planning or concerned authorities	Contractor
3.16	To review the frequency used for Power Line Carrier Communication (PLCC) system to ensure no interference with other power line users	Postal Tele communication Coordination Committee (PTCC)	Owner-PLCC Contractor- Wireless equipment (postal telecommunication)
3.17	No objection certificate for plant layout with regard to electrical equipment, operational safety	Chief Electrical Engineer of Gujarat	Contractor
3.18	No Objection Certificate for storage of construction Materials and chemicals, etc.	Municipal Corporation: Assistant Engineer, Factory Department	Contractor

Sl. No.	Clearances	Authority	Responsibility
3.19	No Objection Certificate for storage of construction fuel oils and chemicals, etc.	Commissioner of Police	Contractor
3.20	No Objection Certificate for storage of Distillate Oil	Chief Controller of Explosives	Contractor
3.21	No Objection Certificate for road opening and asphalting Work including traffic Work.	Municipal Corporation: Assistant Engineer, Roads or concerned authorities	Contractor
3.22	Local approval for operating the plant	Municipal Corporation: Ward Office or concerned authorities	Not applicable
3.23	Local approval of Architectural plans for township	Municipal Corporation or concerned authorities	Owner
3.24	Consent under the Factories Act, 1948 relating to fire fighting capacities	Directorate of Town and Planning of Government of Gujarat	Contractor
3.25	Clearance of Lifts	Inspector of Lifts, Govt. of Gujarat	Contractor
3.26	Approvals / clearances for labour / man power like License from labour commissioner for Construction labour, Registration of Workers or exemption to be claimed if group insurance taken for some, etc.	Concerned Authorities	Contractor
3.27	Any other clearances	Appropriate Authorities	Contractor
3.28	Export Authorisation (Export license)	Appropriate Authorities of exporting country	Contractor

ANNEXURE-III

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

	ITEM	SPECIFICATION REQUIREMENT
A.	Site conditions to be considered	
1.	Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B.	Layout Requirements	
1.	Maximum permissible slope in	
a)	Rail track	1 in 400
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	Required road width	
a)	Main roads Refer Vol. II-G.	
b)	Auxiliary interconnections Refer Vol. II-G.	
c)	Road to the power house unloading bay :	
	• Only for entry to the unloading bay	Yes
	• To pass through the unloading bay	No
3.	Required minimum horizontal distance between the nearest points of	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other building/facility	As per the Tariff Advisory Committee Rules
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

	ITEM	SPECIFICATION REQUIREMENT
4.	Required minimum vertical clearance	
a)	Under pipes/cable racks at road crossings	7.0 Metres
b)	Soil coverage over underground pipes	1.0 Metre (minimum)
c)	Pipe/Cable trench	Not Acceptable
5.	Railway Wagon clearance	Rules of the Indian Railways
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7.	Required level, above the local developed grade level, of	
a)	top of all roads	150 mm
b)	all outdoor paved areas	150 mm
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d)	Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.
BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS		
A.	Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1.	Horizontal, in all directions	
a)	Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm
b)	Adjacent to any other plant facilities (including walls/structures)	1000 mm
2.	Vertical (head-room clearance)	
a)	Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.0 Metre
b)	Under any other plant facilities (including structures, pipes etc.)	2.0 Metre

	ITEM	SPECIFICATION REQUIREMENT
3.	For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4.	Minimum clear hand space required for	
a)	The application of thermal insulation	100 mm
b)	Welding work	150 mm
c)	Bolt tightening	150 mm
B.	Floors, platforms, staircase, ladders, walls, doors & windows	
1.	Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.	Operation & Maintenance Requirement	
a)	Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b)	Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3.	Plinth level of all buildings, above the local developed for power house building.	300 mm, however, 500 mm grade level
4.	Minimum access opening required (with rolling shutter) transportation,	3.5M wide x 4M high or, wherever entry of truck, for material more depending upon the is envisaged equipment size to be handled.

	ITEM	SPECIFICATION REQUIREMENT
C.	Other Maintenance Requirement	
1.	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2.	Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel air oil pumps, filters etc.	Shall be possible without disconnecting or dismant-ling any piping/ducting.
3.	Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4.	Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D.	Central Control Room All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	
a)	False ceiling and false flooring shall be provided.	
b)	Uniform height, colouring schemes for cabinets etc. shall be available.	

ITEM		SPECIFICATION REQUIREMENT
c)	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d)	No opening shall be provided from Boiler side.	
e)	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f)	Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g)	The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h)	Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i)	Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E.	Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

1X800 MW WANAKBORI TPS

TECHNICAL SPECIFICATION

FOR

COMPRESSED AIR SYSTEM

VOLUME-IIB

SECTION C 2- B

(SPECIAL CONDITIONS OF E&C)

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

SECTION-4

SPECIAL CONDITIONS FOR ERECTION AND CONSTRUCTION

C O N T E N T S

SECTION-4

SPECIAL CONDITIONS FOR ERECTION AND CONSTRUCTION

1.0 GENERAL

The following items shall supplement the conditions in the other Sections of this Volume.

2.0 SCOPE OF WORK

2.1 Erection Work

The Contractor shall prepare erection drawings and obtain approval of the same from the Owner as applicable.

The Contractor shall receive the imported Goods, if any, at the port of entry, clear them through Customs and make damage report through port broker. The Contractor shall arrange for payment at prescribed rate of Customs Duties, if required by the Owner, which will be reimbursed by the Owner against Contractor's valid documents upto the overall amount specified in the price bid and agreed.

The Contractor shall transport all imported Goods & indigenous goods from port of entry, from manufacturer's works to the Site and unload all Goods at the Site. Crane services shall be provided by the Contractor, if necessary. All storage at port of entry or at railway station shall be at Contractor's cost.

The Contractor shall be responsible for complete installation as per approved drawings, testing, commissioning, trial run of the Plant at the Site and putting the Plant into commercial operation including finish painting work.

All machinery and tools for transportation and erection shall be provided by the Contractor at his cost.

The Goods after receipt at the Site, shall be checked and verified against the shipping documents and all claims made and replacement or repair order against loss or damage in transit shall be intimated to the Owner. The Goods shall remain under the custody of the Contractor until the Plant is taken over by the Owner upon completion of the Work. The Contractor shall take adequate steps to ensure safety and protection of such Goods. Necessary stores receipt certificates shall be issued to the Owner after the Goods are checked and certified.

No Goods pertaining to the Contract shall be removed from the Site without the consent in writing by the Owner.

The Contractor shall be responsible for replacement, free of cost to the Owner, of any material damaged due to improper storage.

The Contractor shall be responsible for setting up correct reference lines for the purpose of fixing alignments of various equipment. The Contractor shall be responsible for replacement, free of cost to the Owner, of any goods damaged/ lost/broken down in any point of operation due to any reason whatsoever while under the custody of the Contractor.

The Contractor shall arrange for, at his cost, all consumables, paints, lubricants, etc. as required.

The contractor shall arrange at his own cost for approvals, clearances, registration, inspections etc. from but not limited to Government authorities, statutory authorities, e.g. Factory Inspector, Boiler Inspector, Electrical Inspector, Explosive Inspector, Municipal corporation, ESI authorities, Labour authorities etc. for design, engineering, supply, erection and commissioning etc.

All surplus/unused materials/scrap materials left after completion of project shall become property of Contractor, provided the materials were brought by the Contractor and the payment was not made for the same by Owner.

2.2 **Civil, Structural and Architectural Works**

The Contractor shall be responsible for the preparation of the design and all drawings and obtain approval of the same from the Owner when required.

The Contractor shall be responsible for the survey and true and proper setting out of the Works and for the correctness of the positions, levels, dimensions and alignments of the all parts of the Works and shall provide all necessary survey grid-pillars, bench-marks, instruments, appliances and labour in connection therewith. If at any time during the progress of the Works any error shall appear or arise in the positions, levels, dimensions or alignments of any part of the Works, the Contractor, on being required to do so by the Owner/ Engineer, shall at his own expense rectify such errors to the satisfaction of the Owner/Engineer. The checking of the setting out of any line or level by the Owner/Engineer or the Engineer's representative shall not in any way relieve the Contractor of his responsibility for the corrections thereof. The Contractor shall carefully protect and preserve all survey grid-pillars, bench marks, site rails, pegs and other things used in setting out the Works.

The Contractor shall be responsible for all civil, structural and architectural Works as required for the installation of the Plant and its sub-systems and other facilities.

The Contractor shall arrange for supply of all Goods at his cost.

3.0 **INSURANCE**

In addition to the conditions stipulated in Section-3 of this Volume, the Contractor shall also arrange for insurance coverage as under :

a) **Workmen's Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable

under the Workmen's Compensation Act (Government of India). This policy shall also cover the Contractor against claims for injury, disability, disease or death of his or his sub-contractor's employees, which for any reason are not covered under the Workmen's Compensation Act. The liabilities shall not be less than :

Workmen's Compensation	:	As per statutory provisions
Employee's liability	:	As per statutory provisions

b) **Comprehensive General Liability Insurance**

The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and sub-contractors from riots, strikes civil commotion and terrorism.

The hazards to be covered will pertain to all the works and areas where the Contractor, his sub-contractor(s), his agents(s) and his employee(s) have to perform work pursuant to the Contract.

The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

4.0 WORK AT SITE

In the execution of the Work, no persons other than the Contractor, or his duly appointed representative, sub-contractor(s) and workmen employed by him and his sub-contractor(s) shall be allowed to do work at the Site, except by the special permission, in writing, of the Owner or his representative. Access to the Work at all times shall be accorded to the Engineer and representatives of the Owner.

The Contractor shall at all times and at his own cost take sufficient precautions to ensure the safety of public and guard the Site deemed necessary.

The Work at Site shall be carried out without interference with Owner's activities.

No female labour shall be allowed during dark hours.

The Contractor shall not employ for the purpose of executing the Works, any person who is below the age of eighteen (18) years. The Contractor shall pay to each labourer, for the work done by such labourer, wages, not less than the wages paid for similar work in the district.

5.0 MANUFACTURER'S SUPERVISION

If the Contractor is not the manufacturer, he may be required to work under the guidance of the manufacturer's technical personnel. However, this will not

relieve the Contractor of his responsibility for the correctness of work done or quality of workmanship.

6.0 CONTRACTOR'S REPRESENTATIVE

6.1 The Contractor shall employ the necessary competent representatives at the Site, whose name shall have previously been communicated in writing to the Owner/Engineer by the Contractor to supervise the erection of the Plant. The required representatives shall be present at the Site during working hours, and any written orders or instructions which the Owner/Engineer or his duly authorised representative may give to such representative of the Contractor, shall be deemed to have been given to the Contractor.

6.2 The Contractor's representative employed for the purpose of the work at the Site shall be stationed at the Site when the Owner informs the Contractor in writing to that effect.

7.0 FOREIGN PERSONNEL

The Contractor shall bear all expenses in connection of any foreign personnel he plans to bring into India for the performance of the Works.

If the Contractor requires the assistance of the Owner, to the extent possible, to obtain any necessary travel permits for the foreign personnel, the Contractor shall provide the Owner with all necessary data on such foreign personnel. The Contractor shall allow the Owner a reasonable time prior to the proposed date of departure of the foreign personnel, to enable the Owner to provide the assistance required.

The Owner shall assist the Contractor to the extent possible in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Competent Authorities.

The Contractor and the foreign personnel shall abide by statutory laws, rules & regulations in force in India at the time thereof & shall not in any way interfere with Indian political and/or religious affairs. The Contractor's foreign personnel shall work and live in close co-operation & co-ordination with their co-workers and the community and shall not engage themselves in any other employment either part time or full time nor shall they take part in any local politics.

The Contractor shall pay all taxes due in India for the foreign personnel employed by the Contractor for their work in connection with this Contract. The Contractor shall obtain at his own cost "work permits" required from competent authorities to enable the foreign personnel to work in India.

8.0 PROGRAMME OF WORK AND PROGRESS REPORT

The Contractor shall, as required from time to time, submit to the Owner erection and construction schedules in the form of PERT network or bar chart showing the time-table the Contractor proposes to follow to carry out the work with dates and estimated completion times for various parts (milestones) of the Work. Such schedules shall be approved by the Owner, prior to the

commencement of the Work at the Site.

During the progress of the work, the Contractor shall submit copies of monthly progress reports and photographs and such other reports on the erection and construction Works and his site organisation, as the Owner/Engineer may direct. The format of the progress report shall be decided upon by the Contractor with the approval of the Owner. However, if at any time the Owner desires to change the format or requires any additional information, the Contractor shall comply. The Contractor shall also submit an anticipated one (1) months programme at the beginning of each month describing in detail the anticipated programme for the following month. The Contractor shall also submit from time to time, a list of various categories of his employees. Monthly progress reports shall be submitted by the tenth (10th) day of the month following the reporting month.

9.0 INDEMNITY

The Contractor shall, except if and so far as the Contract provides otherwise, indemnify the Owner against all losses and claims in respect of injuries or damage to any person, material or plant, or damage to any property whatsoever but not limited to third party damages which may arise out of or in consequence of the execution of the Works, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in relation thereto.

10.0 CLEAN UP WORK AT SITE

The Contractor shall without any additional payment at all times keep the working and storage areas used by him and/or his sub-contractor(s) free from accumulation of waste materials or rubbish. If these materials are not removed by the Contractor within forty-eight (48) hours, after being requested by the Owner, these will be removed by others and the cost of the same will be charged to the Contractor. Any inflammable materials shall be removed forthwith on request by the Owner.

On completion of erection and construction work, the Contractor shall remove or dispose of in a satisfactory manner all temporary structures, packing cases, waste and debris and leave the premises in a condition satisfactory to the Owner. All surplus earth shall be removed beyond the Plant area and dumped in a place(s) as directed by the Owner/Engineer.

11.0 CO-ORDINATION WITH THE OWNER'S ENGINEERS

The Contractor shall at all times work in co-ordination with the Owner's Engineers and afford them every facility to become familiar with the erection and maintenance of the equipment and construction work.

12.0 MATERIALS HANDLING AND STORAGE

The Contractor shall be responsible for examining the shipment and shall notify the Owner immediately of any damage, shortage, discrepancy, etc. for the

purpose of Owner's information only.

The Contractor shall maintain an accurate and exhaustive record detailing of all Goods received by him for the purpose of erection and keep such record open for inspection by the Owner at any time.

All electrical panels, control gear motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.

All the electrical equipment such as motors, generators etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values shall be maintained by the Contractor. Such records shall be open for inspection by the Owner/Engineer.

The Contractor shall ensure that all the packing materials and protection devices used for the Goods during transit and storage are removed before the Goods are installed.

The consumables and other supplies which are likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality during the storage period.

All the materials stored in the open or dusty locations must be covered with suitable weatherproof and flameproof covering material wherever applicable.

If the materials belonging to the Contractor are stored in area other than those earmarked for him, the Owner will have the right to have them moved to the area earmarked for the Contractor at the Contractor's cost.

The Contractor shall be responsible for providing suitable covered storage facilities to store all Goods which require covered storage. Normally, all the electrical equipment such as motors, control gear, generators, exciter and consumables like electrodes, lubricants, etc. shall be stored in the covered storage space. In addition, the Owner, may direct the Contractor to move certain other materials which in his opinion will require covered storage and the Contractor shall strictly comply with his instruction.

13.0 LABOUR AND LABOUR LAWS

13.1 Recruitment of Local Labour

Local labourers shall be engaged for unskilled work. Preference may also be given for appointment of local labourers in semi-skilled and skilled categories, if such suitable labourers are available.

13.2 Labour Laws and Local Regulations

The Contractor shall abide by the prevailing labour laws and shall have to

obtain a labour license from the appropriate authority as per the law at his cost and shall indemnify the Owner against any financial and other obligation in connection with labourers employed by him. On obtaining the labour license, the Contractor at the appropriate time, shall submit a certified photocopy of the same to the Owner.

13.3 **Wages and Working Hours and Conditions**

The Contractor shall pay wages and observe hours and conditions of labour not less favourable than those established for the trade or industry in the district where the work is carried out. In the absence of any wages, hours or conditions of labour so established, the Contractor shall pay wages and observe hours and conditions of labour which are not less favourable than the general level of wages and hours and conditions observed by other contractors whose general circumstances in the trade or industry in which he is engaged are similar.

13.4 **Contractor to furnish return of labour employed**

The Contractor shall, if required by the Owner/Engineer, deliver to the Owner/ Engineer or to his office a return in such form and at such intervals as the Owner/Engineer may prescribe, showing in detail classes of labour employed and the number employed within each class by the Contractor from time to time on the Site and such information in respect of construction machinery as the Owner/Engineer may require.

13.5 The Contractor shall make his own arrangements for the engagement of all labour and provide on the Site in so far as the Contract otherwise provides, for the transport, housing, feeding and payment thereof.

The Contractor shall, so far as is reasonably practical, having regard to local conditions, provide on the Site, to the satisfaction of the Owner/Engineer an adequate supply of drinking and other water for the use of his staff and labour.

13.6 **Other Requirements**

a) The Contractor shall not, other than in accordance with the Statutes, Ordinances and Government Regulation or Orders currently in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor, or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his sub-contractor(s), agents or employees.

b) The Contractor shall not give, barter or otherwise dispose of to any person or persons any arms or ammunition of any kind or permit the same as aforesaid.

c) The Contractor shall in all dealings with labour in his employment have a due regard for all recognised festivals, days of rest and religious or other customs.

d) In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with any regulations, orders and requirements as may be made by the Government, or the local municipal or sanitary authorities for the purpose of dealing with and overcoming the same.

e) The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his employees.

f) The Contractor shall be responsible for observance by his sub-contractor(s) of the foregoing provisions.

14.0 PROTECTION AND CARE OF WORKS

14.1 The Contractor shall in connection with the Works provide and maintain at his own cost all temporary works, lights, guards, fencing and watching when and where necessary or required by the Owner/Engineer or by any competent statutory or other authority for the protection of the Works.

14.2 From the commencement to the completion of the Works, the Contractor shall take full responsibility for the care of the Works and of all temporary works. If any damage, loss or injury happens to the Works or to any part thereof or to any temporary work from any cause whatsoever (save and except the "Force Majeure" as defined earlier) the Contractor shall at his own cost repair and make good the same so that at completion the works shall be in good order and condition and in conformity in every respect with the requirements of the Contract Documents and the Owner/Engineer's written instructions. The Contractor shall also be liable for any damage to the Works caused by him in the course of any operations he carries out for the purpose of complying with his obligations under the Contract Documents.

15.0 OWNERSHIP OF ARTICLES OF VALUE DISCOVERED AT SITE

All fossils, contains, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall be deemed to be the absolute property of the Owner. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging the same, and shall immediately, upon discovery thereof and before removal, inform the Owner/Engineer of such discovery and carry out, at the expense of the Owner the Engineer's orders concerning the removal of the same.

16.0 CONVENIENCE OF PUBLIC

All operations necessary for the execution of the Works and for the Construction of any temporary work shall, so far as compliance with the requirements of the Contract permit, be carried on so as not to interfere unnecessarily or improperly with the public convenience of access to use public or private roads and foot paths or to use properties whether in the possession of the Owner or of any other person. The Contractor shall indemnify the Owner in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in relation to any violation by the Contractor of the above.

17.0 PREVENTION OF EXTRAORDINARY TRAFFIC AND PROTECTION OF HIGHWAY

The Contractor shall use reasonable means to prevent the highways or bridges communicating with or on the routes to the Site from being subjected to extraordinary traffic by traffic of the Contractor or any of his sub-contractors. In particular the Contractor shall select routes, choose and use vehicles and restrict and distribute loads, so that any such extraordinary traffic as will inevitably arise shall be limited as far as reasonably possible, and so that no unnecessary damage or injury may be caused to such highways and bridges. If it is found necessary for the Contractor to move over part of highway or bridge, one or more loads, where the moving of such load will in all probability damage the highway or bridge unless means of protection or strengthening are carried out, then the Contractor shall, before moving the load on to such highway or bridge, give notice to the Owner of the weight and other particulars of the load to be moved, and his proposals for protecting or strengthening the said highway or bridge. The Contractor shall also carry out the protection and strengthening of the highway or bridge as required.

18.0 WORK MATERIALS AND PLANT

18.1 Materials and Workmanship

All construction materials, structural steel and workmanship shall be of the respective types described in the Contract Documents, and shall be subjected from time to time to such tests as stipulated in the approved quality assurance plan. The Contractor shall establish on site testing facilities as required by him. Collection of samples and testing as specified in the Contract Documents including special tests, if any, shall be carried out by the Contractor at his cost.

18.2 Examination of the Works

No work shall be covered up or put out of view without the approval of the Owner/Engineer and the Contractor shall afford full opportunity for the Owner/Engineer to examine and assess any work which is about to be covered up or put out of view, and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Owner/Engineer whenever any such work or foundation is ready for examination. The Contractor shall uncover any part or parts of the Works, make openings in or through the same as the Owner/ Engineer may from time to time direct and shall reinstate and make good such part or parts to the satisfaction of the Owner/Engineer. If any such part or parts have been covered up or put out of view after compliance with the requirements of this item and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating and making good the same, shall be borne by the Owner as mutually agreed upon but in any other cases all the such expenses shall be borne by the Contractor or may be deducted by the Owner from any money due or which may become due to the Contractor.

18.3 **Improper Work and Material**

The Owner/Engineer shall during the progress of the works have the right to order in writing from time to time:

a) The removal from the Site within such time or times as may be specified in the Contract Documents of any materials which in the opinion of the Owner/Engineer are not in accordance with the Contract Documents.

b) The substitution of proper and suitable materials, and

c) The removal and proper re-execution (notwithstanding any previous test thereof or interim payment thereof) of any work which in respect of materials or workmanship is not, in the opinion of the Owner/Engineer, in accordance with the Contract Documents.

In case of default on the part of the Contractor in carrying out orders, the Owner shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Owner or may be deducted by the Owner from any money due or which may become due to the Contractor.

18.4 **Temporary Arrangement**

The Contractor shall bear all expenses and charges for special or temporary way-leaves required by him in connection with access to the Site.

19.0 **ERECTION/CONSTRUCTION TOOLS, TACKLES AND MACHINERY**

19.1 **Tools, Tackles and Machinery**

The Contractor shall provide all construction/erection machinery, tools, tackles and scaffolding required for the Works. A detailed list of the above, together with their capacities and present conditions, etc. shall be submitted to the Owner/Engineer at least three (3) months before the commencement of Site work.

19.2 **Exclusive use of Machinery**

All erection and construction machinery, temporary works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Work, and the Contractor shall not remove the same or any part thereof for any other use.

20.0 **URGENT REPAIR WORK**

If, by reason of any accident or failure or other event occurring in connection with the Works, either during the execution of the Works or during the Warranty period, any remedial or repair work is necessary, then the Contractor shall take necessary remedial action. If however the Contractor is unable or unwilling to

do such repairs, the Owner may use his own or other workmen to do the repairs. The cost of repairs so done shall be charged to the Contractor or may be deducted by the Owner from any money due or which may become due to the Contractor.

1X800 MW WANAKBORI TPS

TECHNICAL SPECIFICATION

FOR

COMPRESSED AIR SYSTEM

VOLUME-IIB

SECTION C 2- B

(GENERAL CONDITIONS)

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR PROJECT ENGINEERING MANAGEMENT

PPEI, NOIDA-INDIA

SECTION-3

GENERAL CONDITIONS

C O N T E N T S

SECTION-3
GENERAL CONDITIONS

1.0 APPLICATION

These General Conditions shall govern the Works.

2.0 DEFINITION OF TERMS AND INTERPRETATION

2.1 Definitions:

- In this Contract (as defined below), unless the context requires otherwise, the words and expressions defined below shall have the meaning hereinafter assigned to them.

- "**Advance Payment Bank Guarantee**" shall have the meaning assigned to the term under Clause 8.2 of this GCC.

- "**Annexure**" shall mean all appendices; annexure, tables and schedules annexed to this Contract or incorporated by reference herein and shall include all amendments and revisions thereto made by mutual agreement of the Owner and Contractor in accordance with the provisions contained in this Contract.

- "**Acceptance Test/Performance Guarantee Test**" for equipment /system shall mean such tests as are required to determine and demonstrate guaranteed capacity, efficiency and operating characteristics of the equipment /system Plant as stipulated in the Contract Document.

- "**Applicable Laws**" shall mean Constitution of India, all laws, treaties, ordinances, rules, directives, regulations and amendments thereto made from time to time and in force and effect in India, judgments, decrees, injunctions, writs and orders of any court, arbitrator or authority, rules, regulations, orders and interpretations of any Governmental Instrumentality, court or statutory or other body having jurisdiction over the subject matter of the Contract, as may be in effect at the time of performance of Work hereunder by the Contractor, provided, however, that if at any time the Applicable Laws are less stringent than the standards set forth in the Contract, Contractor shall not be excused from meeting the standards set forth herein.

- "**Approved**" and "**Approval**", where used in the Contract shall mean respectively, approved by and the approval of the Owner or the Owner's Representative in writing.

  When the words 'Approved', 'Approval', 'subject to Approval', 'Satisfactory', 'Equal to', Proper', 'Requested ', 'As directed', 'Where directed', 'When directed', 'Determined by', 'Accepted', 'Permitted', or words and phrases of like import are used the approval, judgment, direction etc is understood to be a function of the Owner or the Owner's Representative.

- "**Auxiliary Power Consumption**" shall mean the electrical energy (in kW) consumed by all the equipments, systems etc. forming part of the Plant and provided by the Contractor in pursuance of the Contract over a period of one hour i.e. difference of Gross Power measured at Generator Terminals and Net Power measured at 400 KV side of Generator Transformers, when the Plant is operating at rated capacity (guaranteed) measured in accordance with the procedures detailed in the Technical Specifications.

- "**Bidder**" shall mean duly established reputed organizations, manufac-turers, etc. having requisite financial and technical capability and experience of participating in the Bid invited by the Owner for the Works. [

- **"Bank Guarantee" or "Performance Bank Guarantee" or "*Bonds"*** shall mean the primary, irrevocable, and unconditional on demand bank guarantees from Indian nationalized bank, to be furnished by the Contractor as a security for his performance under the Contract and the Advance Payment payable to.the Contractor in accordance with Clauses of the General Conditions of Contract.

- **"Cause"** in relation to the revocation or amendment of any Permit shall mean any fact or circumstance, including without limitation any default, neglect or failure to abide by any of the terms and conditions of such Permit, which legally entitles the issuing authority to revoke the Permit or make the relevant amendment in its terms and conditions.

"Ceiling" shall ***mean an upper limit for payment inclusive of applicable taxes & duties, by the Owner to the Contractor for various services rendered in pursuant to Contract as well as deduction towards Liquidated Damages for delay in Commercial Operations or otherwise shortfall in Performance Guarantee***

- **"Contractor"** shall have the meaning assigned to the term in the Contract Agreement and shall include its legal successors in title approved by the Owner, who satisfy the qualification criteria set forth in the Tender Document,

- **"Contract"** or **"EPC Contract"** shall mean the Contract Agreement, Contract and such further documents as may be expressly incorporated in the Contract by reference and all amendments in writing made to any of them in accordance with the provisions contained in this behalf in the Contract and executed by duly authorized representatives of the Parties and shall include such other document that the Parties may have agreed in writing.

- **"Consultant"** shall mean Development Consultants Pvt. Ltd., Consulting Engineers, whose office is situated at GR. HQ.: 24 Park Street, Kolkata – 700 016, or any other agency (engaged for specific purpose) appointed by the Owner for the Project implementation and shall include their duly authorized representatives.

- "**Change in Law**" shall mean the occurrence of any of the following after

[*please insert the date*]:

(a) the enactment of any new Applicable Law.

(b) any modification or repeal of any existing Applicable Law or any new or modified directive or order there under,

(c) Any change in the interpretation or enforcement of any Applicable Laws by a competent legislature of Government Agency in India which is contrary to the existing accepted application or interpretation thereof, provision for which has not been made elsewhere in the Agreement.

provided that "Change in Law" shall not include

(i) any change in the interpretation or application of any Applicable Law except as provided in (c) above; and

(ii) any enactment, modification, repeal, interpretation or application of any Applicable Law of India which increases market prices of goods, commodities, labour and services in general.

- "**Change Order**" shall mean a written order from the Owner to the Contractor after the Commencement Date of the Contract requiring a change in any part of the Work that may involve:

  (a) a change in the scope of Work,

  (b) additional work, or

  (c) the omission of a portion of the Work, and

  (d) if appropriate, an adjustment in one or more of the (i) Contract Price, (ii) Guaranteed Commercial Operation Date, (iii) Milestone Payment Schedule, (iv) any of the Performance Guarantees, or (v) any provision/scope of this Contract including any Appendices or Schedules hereto.

- "**Codes**" or "**Indian Standards and Codes**" shall mean the latest applicable Indian and international technical codes and standards, whether required by statute or not.

- "**Commencement Date**" or "**Zero Date**" shall mean the date on which the Contractor is to commence performance of Work or its obligations under the Contract as specified in the Notice to Proceed delivered by the Owner to the Contractor under and in accordance with the Contract.

- "**Commissioning**" shall mean the first successful operation of each equipment / systems provided by the Contractor, and the Plant as a whole at full load (after the Mechanical Completion), without any problem/interruption, in accordance with the Contract, after all initial adjustments, cleaning, re-assembly, and Trial Run, as required on completion of installation of Plant at site, have been completed.

- **"Commercial Operation"** shall mean, operation of the Plant upon Commissioning and successful completion of all the Tests before Commercial Operation.

- **"Commercial Operation Date"** or **"COD"** shall mean the date mentioned in the Provisional Acceptance Certificate which will be issued by the Owner, upon the satisfactory completion of reliability run and Plant entering into Commercial Operation, and the Plant becoming available for continuous operation on 24X7 basis for commercial sale of power by Owner,.

- **"Company Contractor"** shall mean any Person other than the Contractor under contract with the Owner with respect to the Project.

- **"Completed Performance Test"** shall mean with respect to each equipment / systems / Plant, the Performance Test conducted in accordance with the contract during which the equipment / systems / Plant and the operation thereof comply with all Applicable Laws and the Performance Guarantees and which are established as completed Performance Test in accordance with the provisions of the contract in this behalf herein.

- **"Confidential Information"** shall mean information now or hereafter owned by or otherwise within the possession or control of a Party, including patented and unpatented inventions, business and trade secrets, know-how, techniques, data, specifications, as-built drawings, blue prints, flow sheets, designs, engineering information, Construction information, operation criteria, and other intangible information related to the Project.

- **"Consequential Damages"** shall mean indirect, punitive, special or incidental damages, the loss of profits or revenue, loss of use of the Equipment or any associated equipment, cost of capital and/or financing, down time costs, loss of opportunity, loss of goodwill, and claims of customers for such damages, except the damages provided under the Contract.

- **"Consignee"** shall mean the authorised representative or officer of the Owner to whom the Equipment is required to be delivered in the manner indicated in the Contract and whose identity shall have been notified by the Owner in good and sufficient time having regard to the Contractor's schedule for the delivery of the Equipment.

- **"Consumables"** shall mean all lubricants, lubrication and control oils, greases, filters, jointing & packing materials, hardware, demineralising resins and water treatment chemicals etc. required for operation of the Plant.

- **"Contract Agreement"** shall mean the agreement signed by the Parties to which these General Conditions of Contract, Schedule of Liquidated Damages and other documents and agreements forming part of the Contract are scheduled.

- " **Project Network/ Master Network**" shall mean the Network covering details like:

  design, engineering & manufacturing and procurement schedule for the Equipment identifying all systems and Equipment and milestone dates for manufacture, assembly, inspection/ shop testing, shipment and delivery.

  erection, Commissioning and testing schedule till Take-Over,

  design, engineering, Construction, fabrication schedule for the Project identifying all buildings, structures and milestone dates for various Construction activities.

  Bar chart covering critical and parallel activities indicating period

- "**Contract Period**" shall mean the period from the Commencement Date/ Zero Date till Take Over of the Plant. Provided that the expiry of the Contract Period shall not affect the obligations of the Contractor beyond the Contract Period, as specified under the Contract

- "**Contractor's Works**" or "**Manufacturer's Works**" shall mean the places which are used by the Contractor or any of its sub-vendor/sub-contractor for the manufacture of Equipment for the Plant or performance of Work, designated by Contractor and communicated to the Owner.

- "**Contractor's Equipment**" shall mean all machinery, apparatus, equipment, appliances, materials, items and other things of whatsoever nature required for the execution and completion of the Works, performance of the Contractor's obligations under the contract including Work, establishing of Performance Guarantees, and the remedying of any defects and deficiencies, but does not include Equipment and other things intended to form or forming part of the Plant.

- "**Contractor Permits**" shall mean all those Permits, required by the Contractor from any Government Instrumentality for the performance of any of the obligations of and Work by the Contractor under the Contract, including without limitation, all registrations and licenses required to permit the Contractor to do business in the jurisdiction where it has to perform any part of the work, inclusive of all the Permits, authorizations, consents and approvals required solely for Construction, Commissioning, testing operation of the Plant and transmission of electricity to GETCO.

- "**Contractor's Representative**" shall mean the person named as such in the Contract or other person appointed from time to time by the Contractor in his place in accordance with the Contract, , and such appointment communicated to the Owner,.

- "**Country**" shall mean India, where the works are to be executed and to which Equipment are to be delivered.

- "**CIF Price**" shall mean delivery free of expenses to the Owner on board the

vessel at the port of entry including the insurance and freight charges.

- **"Contract Document"** shall mean and include the General Conditions of Contract, Special Conditions of Contract, Minutes Of Meeting dated [*insert*] between Owner and the Contractor, the Final Proposal of Contractor dated [*insert*] as accepted by the Owner, Specifications, Schedules, Annexures, Drawings, Schedule of Prices and Schedule of Quantities submitted by the Successful Bidder, Letter of Intent, Notice to Proceed issued by the Owner, subsequent amendments to the foregoing in accordance with the terms of the Contract.

- **"Contract Price"** shall mean the agreed sum of money stated in the Contract to be paid to the Contractor for the successful completion of the Works and obligations, in accordance with the terms of the Contract.

- **"Day"** or **"Days"** shall mean a Gregorian calendar day

- **"Defects Liability Certificate"** shall mean the certificate, which the Owner shall issue to the Contractor when the Warranty Period or Extended Defects Correction Period, which ever is later, for the Plant including Equipments has expired, and the Contractor has fulfilled all his obligations under the Contract for such defects.

- **"Directive or Owner's Instructions"** shall mean any requirement, instruction, clarification, direction, order, regulation, code, standard or rule of any Competent Authority, which is legally binding and any modification, extension or replacement issued by the Owner or the Consultant in writing to the Contractor from time to time during the subsistence of the contract.

- **"Documents"** shall mean all design documents, engineering documents, drawings, calculations, computer software (programs), computer diskettes and tapes, audio and video tapes, samples, patterns, models, Construction documents, erection documents, quality plans, inspection reports, field quality plans and test reports, operation and maintenance manuals, and other manuals, and all other data and information to be submitted by the Contractor and shall include without limitation engineering, design and Construction drawings, data sheets, specifications, plans, bills of materials and estimates etc.

- **"Drawings" shall *mean***

  a) Drawing furnished by the Consultant/Owner .

  b) Supplementary drawings if any furnished by the Consultant/ Owner to clarify and to define in greater detail the intent of the Contract.

  c) Drawing submitted by the Contractor with his Final Proposal provided such drawings are acceptable to the Consultant/ Owner.

  d) Drawing furnished by the Consultant/Owner to the Contractor

during the progress of Work.

e) Engineering data and drawings submitted by the Contractor during the progress of Work, provided such engineering data and drawings are acceptable to the Consultant/Owner.

- "**Engineer**" shall mean an officer of the Owner as may be duly appointed and authorised in writing by the Owner for the purpose of the Contract.

- "**Equipment**" **or "Equipments" or "Equipment(s)"** shall mean all of plant, systems, equipments, and Materials specified in Schedule to be supplied under the Contract and such other equipment and materials as may be agreed between the Owner and the Contractor, necessary for incorporation in the Plant.

- "**Extended Defects Correction Period**" shall mean, in relation to any individual item of Work or Equipment comprised in the Works, which has been rectified, repaired, or replaced, twelve (12) months from the date of such rectification, repair or replacement or twenty four (24) months from the date of COD of the Plant whichever is later.

- "**Ex-Works**" shall have the meaning ascribed thereto under Incoterms.

- "**Facility**" or "**Plant**" shall mean the **1x800 MW** supercritical thermal power plant including , all the Equipments, together with all auxiliaries, and related buildings and Civil works of the said power plant to be constructed at Wanakbori, Kheda District, Gujarat, India, as an integrated whole, including without limitation all systems and sub-systems thereof and related facilities, including without limitation any and all appliances, parts, instruments, appurtenances, accessories and other property that may be incorporated or installed in or attached to or otherwise become part of the Plant or as envisaged in the Contract or which otherwise constitutes a part of the Plant and located on Site.

- "**Facility Site**" or "**Site**" shall mean land at Wanakbori, Kheda District, Gujarat, India, owned by Owner on which the Facility will be located, as more particularly identified on the site plan and as described in drawings attached to Contract hereto as Annexure [insert].

- "**TAKE OVER CERTIFICATE**" shall mean, in relation to the Plant, the certificate issued by the Owner confirming the Owner's Take Over of the Plant as being complete in every respect in accordance with clause No. 20.0 of the General Conditions of Contract, after Provisional Plant Acceptance Certificate is issued and liquidation of the punch lists and pending issues, after completion, synchronization and placed in Commercial operation in accordance with the contract, except for the warranty in respect of Plant/Equipments under the Extended Defects Correction Period, Latent Defects and Warranty for Mandatory Spares.

- "**Final Proposal**" shall mean the document containing the final technical & commercial proposal of Contractor for the Plant as may be modified in accordance with the provisions of the Tender Document, and agreed to in writing by the Owner and shall include but not be limited to technical information, data, documents and drawings forming part thereof, annexed as Annexure [inesrt] to the Contract.

- *"Financial* Closure*"* ***shall mean the date on which the Financing Documents providing for funding by the Lenders have become effective.***

- "**Financing Documents**" shall mean any and all agreement or agreements, notes, bonds, indentures, political risk insurance policies, credit agreements, debt repayment or refinancing instruments, reimbursement agreements, mortgages, security agreements, guarantees, registration statements, disclosure statements, subordination agreements, partnership agreements, lease agreements, participation agreements and other documents relating to the Construction, interim or long-term financing (and any refinancing of the same) of the Project, including any modifications, extensions, renewals or replacements of the same entered into by the Owner for the provision of finance in connection with the Project.

- "**First Synchronisation**" shall mean electrical connection of plant to the Grid by Interconnection of the Facility for the first time after matching of voltage, phase sequence and frequency after satisfactory Commissioning of TG and STG.

- "**Force Majeure**" shall have the meaning setforth in clause 28.0 of these General Conditions of the contract.

- "**Foreign Currency**" shall mean a freely convertible currency such as US $, Japanese Yen, Pound Sterling, Swiss Francs & Euro specified in the Schedule of Prices and Schedule of Delivery in which the Contract Price is payable, but not Indian Rupees.

- **"F.O.B"** shall mean delivery free of cost to the Owner on board the vessel at the port of shipment.

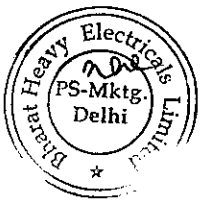
- **"F.O.R. Destination"** shall mean delivery free of expenses to the Owner on board rail wagons at the railway siding at the Site or its nearest railway station including the insurance coverage.

- **"F.O.R. Works"** shall mean loaded and stowed or trimmed free of expenses to the Owner on board rail wagons at the Contractor's Works siding or it's nearest railway station for transportation.

- "**F.O.R. Site**" shall mean delivery free of expenses to the Owner at his Site.

- "**GUVNL**" shall mean Gujarat Urja Vikas Nigam Limited including its successors in title and assigns of its interest.

- "**General Conditions of Contract**" or "**GCC**" shall mean these Conditions of Contract' as amended in accordance with the provisions contained in this behalf herein.



- "**Guaranteed Commercial Operation Date**" shall mean the date by which the Contractor has guaranteed to make the Plant ready for Commercial Operation after successful completion of Reliability Run.

- "**Guaranteed DM Water Consumption**" shall mean the guaranteed demineralised water consumption for the plant operation as stated at CL3.02.01 of VOL IIA/S-10

- "**Good Engineering Practices**" shall mean those practices, methods, acts, techniques and standards as may be followed or employed in the performance of the work and discharge of its obligations by the Contractor and which (i) are generally accepted internationally for use in the electric utility industry, taking into account conditions in India, in connection with power plants of the same or similar size and type as the Plant, (ii) are commonly used in prudent electric utility engineering, construction, project management and operations, and (iii) would be expected to result in performance of the services and completion of Works in a manner consistent with Applicable Laws, Applicable permits, reliability, safety, environmental protection, economy and expediency.

- "**Government Instrumentality**" or "**Competent Authority**" shall mean the Government of India, the Government of Gujarat, or any political subdivision, ministry, department, agency, corporation, commission or any regional, local or municipal authority or governmental body thereof or any other governmental or statutory body under the direct or indirect control of the Government of India or Government of Gujarat, or of any political subdivision, ministry, department, agency, corporation, commission, or any regional, local or municipal authority or governmental body thereof, and shall include without limitation any other governmental or statutory body in India having jurisdiction over the Plant or over the performance of any part of Work or the Works or any obligation of the Contractor or the Owner under the contract.

- "**Grid**" shall mean the system of electrical transmission and distribution of GETCO interconnecting different generating stations, transmission lines, sub-stations, circuits, transformers, switchgear and other equipment upto and on the GETCO side of the Interconnection Point.

- "**GETCO**" shall mean the Gujarat Energy Transmission Corporation Limited.

- "**Goods**" shall mean Equipment to be supplied under the Contract

- "**Reliability Run**" shall mean the first continuous operation of the Plant with sub-systems under varying loads to demonstrate satisfactory operation for a specified period (14 days) after completion of successful Initial Operations and conditions as specified elsewhere in the Contract.

- "**Hazardous Materials**" shall mean (i) hazardous materials, hazardous wastes, hazardous substances, toxic substances or contaminants as those terms are defined under any environmental law or regulation, including, but not limited to, Applicable Laws, and in the regulations

adopted or promulgated pursuant thereto; (ii) petroleum and petroleum products including crude oil and any fractions thereof; (iii) any other hazardous, radioactive, toxic or noxious substance, material, pollutant, or solid, liquid or gaseous waste; and (iv) any substance that, whether by its nature or its use, is subject to regulation under any environmental law or with respect to which any applicable environmental law or any Governmental Instrumentality requires environmental investigation, monitoring or remediation.

- "**Incoterms**" shall mean "**International Rules for the Interpretation of Trade Terms**," as adopted by the International Chamber of Commerce (the "ICC") and as in force on the date of invitation of the bids. All matters relating to the Construction and interpretation of Incoterms shall be resolved by reference to the Guide to Incoterms.

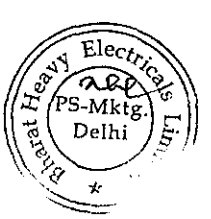
- "**Taxes**" shall mean all taxes, duties, and cess imposed by the Government of India or any of its subdivisions (including value added tax), excise, storage and consumption taxes, service tax, import duties and customs duty and fees, license fees, sales and/or purchase taxes, octroi, entry tax, and labour cess applicable to any portion of the Works or Supplies, or any other tax, duty or fee of similar nature irrespective of the nomenclature used for the same

- "**Personal Taxes**" shall mean all taxes on income, profit, other real and personal property and franchise taxes, as well as personal income taxes of the Parties or any authorised persons acting on behalf of the Parties; and all applicable national, state and local payroll, social security, workers' compensation, employment taxes and contributions imposed by Applicable Law with respect to or measured by compensation (wage, salaries or other) paid to employees of the Parties, including taxes, health and welfare funds, pensions and annuities, disability insurance and all other similar social payments.

- "**Initial Operation**" with respect the Plant shall mean all operations undertaken as part of "Commissioning" after completion of "Preliminary Operation" first synchronization and upto commencement of "Trial Run". It shall be the first integral operation of the Plant including all Equipment / Systems, and shall include first light up / initial equipment rolling, equipment stretch-out, dry-out and operational chemical cleaning, no-load / partial load / full load runs for mechanical / electrical tryout and gathering of operational data; calibration, setting and Commissioning of control systems; and shutdown inspection and adjustment after running trials of the Plant including the Equipment.

- "**Inspector**" shall mean the authorized representatives appointed by the Owner or the Consultant for purpose of the inspection of Equipments for the purposes of the Contract.

- "**Interim Payment Certificate**" shall mean any payment certificate other



than Final Payment Certificate, issued by the Owner or Owner's Representative pursuant to clause 8.12.1 other than the final payment certificate.

- "**Interconnection Facility**" shall mean all the facilities to be provided by the GETCO on the Site on GETCO's side of the Interconnection Point the location of which is specified in the Technical Specifications.

- "**Interconnection Point**" shall mean the 400kV Switchyard outgoing gantry from where the power is evacuated to the Grid by GETCO.

- "**Intellectual Property Rights**" or "**IP Rights**" shall mean copyright, all rights conferred under statute or common law in relation to inventions (including patents), registered trademarks, registered designs, circuit layouts, confidential information and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields

- **"Latent Defect"** shall mean the defects in design, materials and could not have been found prior to expiry of the Warranty Period mean a defect, which was in existence during the applicable Warranty period but was not reasonably discoverable during such Warranty period.

- "**Lenders"** shall mean those banks, firms or institutions who make available, from time to time, financing for the Project and whose identities have been notified to the Contractor.

- "**Letter of Intent" or "LoI"** shall mean the formal communication in writing by the Owner to the Contractor of the acceptance of the Contractor's Bid.

- "**Lien(s)**" shall mean any lien, claim, charge, encumbrance, cause of action, security interest, mortgage or other possessory or non-possessory interest in, on or against real, tangible or intangible property as administered under Applicable Law arising out of, due to, or otherwise as a result of the Contractor's acts or omissions, including any lien recorded or held by any Sub-Contractor or any other person entitled to a lien under Applicable Law.

- **"Limits of** Rejection" shall mean the limits prescribed to each of the Performance Guarantees, which if not adhered to, the Project shall be liable for rejection

- "**Liquidated Damages**" shall have the meaning as specified in 11.0 of the GCC.

- "**Local Currency**" shall mean the Indian Rupees.

- "**Manufacturer**" shall mean any entity or firm who is the producer and furnisher to the Contractor of any material or designer and fabricator of any equipment I systems which is to be incorporated in or forms part of the plant / works.

- **"Mandatory Spares"** shall mean the mandatory spares, and maintenance tools and tackles for the Plant, as specified in the Specifications, to be supplied by the Contractor under the Contract.

- "**Materials**" shall mean things of all kinds to be provided and incorporated in the Plant by the Contractor, including the items which are to be supplied by the Contractor under the Contract.

- "**Mechanical Completion**" shall mean with respect to the Plant, the completion of all works by the Contractor including completion of Construction, erection, installation , calibration and construction; testing services with respect to all mechanical, electrical, civil & structural, instrumentation and control systems (including Equipment) of the Plant, and the Plant has achieved a state of readiness for "Preliminary Operation". The existence of Punch List and pending issues items which do not prevent or adversely affect the Plant performance and safety, from being in a state of readiness for "Preliminary Operation" shall not be construed as preventing the Plant, from achieving Mechanical Completion.

- "**Milestone Payment Schedule**" shall mean the document, provided in Annexure [insert] hereof which sets forth (i) payments to be made by the Owner to the Contractor on schedule specified therein, and (ii) links each such payment with Project Milestones commencing on the Commencement Date. The Milestone Payment Schedule divides the contract price payment among certain progress milestones and may otherwise be adjusted from time to time in accordance with the contract.

- "**Month**" shall mean a month according to Gregorian calendar.

- "**Monthly Progress Report**" or "**Progress Report**" shall mean a progress report meeting the requirements set forth in clause 29 of the specification hereto.

- "**Notice to proceed**" or "NTP" shall mean the Owner's letter or notification intimating the Contractor to commence the Works.

- "**Notice in Writing**" or "**Written Notice**" shall mean a notice in writing, typed or printed or hand written characters, sent (unless delivered personally or otherwise proved to have been received) by registered post or by any agreed system of electronic transmission to the last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered.

- "**Operation Manual**" shall have the meaning set forth in Specification hereof.

- "**Owner**" or "**Purchaser**" shall mean Gujarat State Electricity Corporation Limited (GSECL) and shall, unless repugnant to the context thereof, include its successors, assigns as well as authorized officers & representatives.

- "**Owner's Representative**" shall mean the person appointed by the Owner from time to time and notified as such to the Contractor to act as Owner's Representative for the purposes of the Contract.

- "**Owner's Instructions**" or "**Owner's Representative's Instructions**"

shall mean any drawings, specifications, instructions, details, directions and explanations, in writing issued by the Owner or by the Owner's Representative /Consultant from time to time during the subsistence of the Contract

- **"Owner or Purchaser"** shall mean Gujarat State Electricity Corporation Limited and shall include its successor(s) and assigns.

- **"Prime Bidder"** shall mean a reputed organization who submits a Bid and assumes single point responsibility acting by himself or on behalf of his associates. The Prime Bidder will be the party who will be contractually bound to the Owner.

- "**Owner Permits**" shall mean those Permits, No Objection Certificate (NOC), authorizations, consents and approvals required by the Owner to own, posses, operate and maintain the Plant and to generate electrical energy there from,

- "**Party**" shall mean either of the Owner or Contractor individually and "**Parties**" shall mean Owner and Contractor collectively.

- "**Permanent Works**" shall mean the permanent works, equipment and materials including all civil, electrical, control & instrumentation and mechanical works to be designed, engineered, manufactured, supplied, installed, erected, executed, Commissioned in accordance with the Contract and which form part of the Plant.

- "**Performance Guarantees**" shall mean the guaranteed capacity, efficiency and operating characteristics of the Plant as stipulated in Schedule of the Contract and Specifications.

- "**Performance Guarantee Tests**" shall mean, the tests specified in the Specifications and Schedule of the Contract to be conducted by the Contractor after entry into Commercial Operation of the Plant at the Site by the Contractor, other than the Tests before Commercial Operation, which shall be performed to demonstrate the achievement of Performance Guarantees, and shall be successfully conducted within three (3) Months of entry into Commercial Operation of the Plant.

- "**Performance Test**" with respect to the equipment/systems of the Plant shall mean the test to establish their design / rated performance conducted at site by the Contractor in accordance with the provisions of the contract.

- **"Permit"** shall mean any valid permit, authorization, license, registration, approval, consent, waiver, exemption, variance, franchise or any similar order of or from of any Government Instrumentality, court or other body having jurisdiction over the matter in question.

- **"Person"** shall mean any individual, corporation, partnership, association, joint stock company, trust, unincorporated organisation, joint venture, government or political subdivision or agency thereof.

- "**Port of Entry**" shall mean the final destination in India (sea or airport)

where customs duty, port and other handling charges are paid on imported materials.

- "**Power Purchase Agreement**" shall mean the Agreement between the Owner and the GUVNL for sale of electrical energy generated by the Facility to GUVNL.

- "**Preliminary Operation**" shall include all activities undertaken as part of Commissioning after Mechanical Completion up to commencement of Initial Operation and shall include mechanical and electrical checkouts, adjustments, calibration of instruments and protection devices, Commissioning of sub / supporting systems and static chemical cleaning of the Plant.

- "**Project**" or "**Plant**" shall mean the Facility and the work as an integrated whole, all as described in greater detail in the specification hereto.

- "**Project Documents**" shall mean the Power Purchase Agreement, the Financing Documents, the Contract, any Operation and Maintenance agreement in respect of the Plant, all fuel purchase agreements, all fuel transportation agreements and all other contracts relating to the Plant entered into by the Owner and shall include all Drawings and documents
- "**Protocol**" shall mean the statement of readings of any or all of Tests Before Commercial Operation and/or Performance Guarantee Test or any other tests performed by the Contractor under the Contract (which test has been witnessed by the Owner) and jointly signed by Owner and/or his representative or Inspector and Contractor and/or his representative.

- "**Provisional Acceptance Certificate**" shall mean the certificate issued by the Owner to the Contractor evidencing achievement of the COD by the Contractor.

- "**Prudent Utility Practices**" shall mean those practices, methods, equipment specifications and standards of safety and performance, as the same may change from time to time, as are generally accepted for use in electricity generating utilities taking into account conditions in India and commonly used in prudent electricity generation utility engineering and operations including design, engineering Construction, erection, Commissioning, operation and maintenance of power generating stations and equipment comprised therein lawfully, safely, efficiently and economically for facilities of the type and size similar to the Plant and that generally conforms to the Equipment manufacturer's operation and maintenance guidelines.

- "**Punch List**" shall mean the list in respect of the equipment / systems supplied / erected / commissioned, first prepared by Owner at the time of issuance of Provisional Acceptance Certificate of the equipment / systems, and thereafter periodically revised by Owner as necessary, which list shall set forth certain items of Work which remain to be performed by the Contractor in order to ensure that the Plant fully complies with all of the standards and requirements set forth in the Contract.

Provided, the Punch List and pending issues shall not include any items of work, alone or in the aggregate, the non-completion of which prevents the Plant as a whole from (a) being used for its intended purposes as described in the Contract in accordance with Applicable Laws and Applicable Permits or (b) being legally, safely and reliably placed in commercial operation

- "**QA Programme**" shall mean the comprehensive quality control and quality assurance programme to be followed by the Contractor in executing the Supplies, Construction/ Erection of the Works.

- "**Risk Transfer Date**" shall, subject to the obligation of the Contractor including, without limitation, in relation to the Performance Guarantee Test (and consequences of failure thereof including rejection) and Warranty, mean the date on which the Owner assumes the care and custody of the Equipment/Plant or the Plant enters in to Commercial Operation whichever is earlier.

- "**Schedule**" shall mean collectively all the schedules including Project Schedule, Milestone Schedule and other schedules pertaining to the work and the Plant as detailed in the Contract.

- "**Specifications**" or "**EPC Specification**" or "**Technical Specification**" shall mean collectively, the description of the scope, the Owner's requirements, design criteria, technical requirements, Final Proposal, drawings, programme of work Project Schedule, all Appendices to the contract, Appendices to these General Conditions of contract, Performance Guarantees, all terms and stipulations of the contract, and such amendments and revisions, as may be made in the Tender Documents or to the contract and all written agreements made after the execution of the contract by the Parties, or which may pertain to the method and manner of performing the work under the contract as agreed.

- "**Sub-contractor**" shall mean any Person (other than the Contractor or the Owner) to whom any part of the Works has been sub-contracted by the Contractor in accordance with the Contract and with prior approval of the Owner, or with whom the Contractor has entered into any contract for the supply of any Equipment in connection with the Works and with prior approval of the Owner, and shall include its legal successors in title or permitted assigns, and unless otherwise stated, all the Sub-contractors and suppliers to such Person and the term Sub-Contract shall be construed accordingly.

- "**Supplies**" shall mean the supply of the Equipment and the Mandatory Spares by the Contractor in connection with the performance of its obligations under the Contract, including all incidental activities thereto,

- "**Site**" shall mean the land and other places including existing roads and paths put at the disposal of the Contractor by the Owner in connection with the execution of the Contract.

- **"Synchronisation"** shall mean electrical connection of the Plant to the Grid by means of the Interconnection Facility for the first time where the Plant and the Grid are matched in voltage, phase and frequency, after satisfactory Commissioning.

- **"Take Over"** or **"Taking Over"** shall mean taking-over of the whole Plant by the Owner for the purpose envisaged under the Contract after Commercial Operation Date and after successful completion of Performance Guarantee Tests complete within three months from the Commercial Operation of the Plant and successful completion of Tests Before Take Over, as well as liquidation and completion of pending items specified in Punch List in pursuant of the Contract.

- **"Temporary Works"** shall mean all temporary works of every kind (other than Contractor's Equipment) required for the execution and completion of the Works and the remedying of any defects.

- **"Tender Documents"** shall mean the documents for Invitation to Bid together with all amendments thereto and clarifications, if any, issued by the Owner or the Consultant from time to time in respect thereof.

- **"Tests before Commercial Operation"** shall mean in relation to the Plant, all tests prescribed in the Specification and any other tests agreed between the Owner and Contractor to be undertaken by the Contractor.

- **"Tests before Take Over" shall mean** the tests prescribed in the 'Specification', and any other such tests as may be agreed between the Owner and Contractor or instructed as a Change Order, which has to be carried out by the Contractor before the Plant is Taken Over.

- **"Tonne"** shall mean 1,000 Kilogram weight.

- **"Transmission Facilities"** shall mean all of the facilities to be located off the Site and to be constructed by or for the GETCO to connect the Interconnection Facilities to the Grid.

- **"Reliability Run Test"** or **"Trial Run"** of the Plant shall mean the Period of 14 days of continuous operation after Synchronization, or extended period thereof if any as more particularly defined at Vol-II A/S-10/CL2.02.02 .

- **"Tests on Completion"** shall mean such tests as are prescribed in the Specifications and/or other tests as mutually agreed upon by the Owner and the Contractor to be carried out by the Contractor to prove satisfactory performance of the Works.

- **"Ton"**, shall mean 1,000 Kilogram weight, "Gallon" shall mean Imperial gallon, unless otherwise mentioned specifically.

- **"Unexpected Archaeological Condition"** shall mean uncovering or revealing of an unknown historical or archaeological site at or contiguous to the Site during performance of the Contract that was not

shown or indicated in the Subsurface Investigation and which Contractor could not have reasonably been expected to be aware of.

- **"Unpriced Technical Bid"** shall mean the unpriced technical bid submitted by the Successful Bidder as part of its Final Proposal

- "**Variation**" shall mean alterations, amendments, omissions, additions, or variations of the Equipment or the Supplies as agreed.

- "**Warranty**" shall mean all guarantees and warranties provided or agreed to be provided under the Contract for and in respect of the equipment, work, components, materials, Supplies and parts and works forming part of or incorporated in the Plant or relating thereto supplied or provided by the Contractor and shall include any guarantee or warranty provided or furnished by a sub-Contractor under a sub-contract.

- **Warranty Engineer**" shall mean, the engineer deputed by the Contractor and staying at site, to be responsible for looking after / supervising Operation and Maintenance practices during warranty period.

- "**Week**" shall mean a continuous period of seven (7) Days.

- "**Wilful Misconduct**" shall mean that the Contractor has intentionally concealed the defect in full knowledge of the serious consequences that may flow from its existence and the defect is one, which the Owner could not have discovered on careful examination of the Plant at the time of commencement of Commercial Operation or during the Warranty Period.

- "**Work**" or "**Works**" shall mean the works and services involving engineering, procurement, Supplies, construction, installation, erection, Commissioning of the Plant and shall include all Permanent Works comprised in or forming part of the Plant and the temporary works or either of them as appropriate, and any other works required to be performed by the Contractor under the Contract.

- "**Warranty Period**" shall have the meaning assigned to the term under Clause 21.2 of the GCC, during which the Contractor shall bear all cost covering repair and/or replacement of any defective part of the Plant/ Equipment supplied, works done and services rendered under the Contract.

2.2 Interpretation of Bid Document

1) General Conditions shall be read in conjunction with Instructions to Bidders, special Conditions, Technical Specifications, Drawings and other documents forming part of the Bid Document wherever permissible or the context so requires.

2) Notwithstanding the sub-division of the Bid Document into sections and volumes, every part of each shall be deemed to be supplementary to and complementary of each other.

3) All headings and marginal notes to the items of the General Conditions

or to the Specifications or to any other document forming part of the Bid Document are solely for the purpose of giving a concise indication of the general subject matter thereof and not a summary of the contents thereof and they shall never be deemed to be part thereof or be used in the interpretation or construction thereof.

4) Wherever it is mentioned in the Bid that the Contractor shall perform certain work or provide certain facilities it is understood that the Contractor shall do so at his cost and the price shall be deemed to have included the cost of such performances and provisions so mentioned.

5) The materials, designs and workmanship shall satisfy the applicable standards, specifications contained herein and codes referred to. Where the Bid Document stipulates requirements in addition to those contained in the standards and codes, those additional requirements shall also be satisfied.

6) For the purposes of the Contract including General Conditions of Contract, the expression "legally, safely and reliably placed in commercial operation" shall mean that the Facility, will operate in the manner intended as described in the contract, in accordance with all Applicable Laws and Applicable Permits, and without undue risk of damage or injury to the Plant or Persons.

7) Words incorporating the singular only shall also include the plural and vice -versa where the context requires.

8) "Writing" shall include any manuscript typed or hand-written or printed statement, including E- Mail and facsimile transmission under or over signature or seal as the case may be.

2.3 Priority of documents

For the purpose of interpretation of the Contract, especially in the event of any inconsistency, the following order of precedence shall apply:

Order of Precedence:

The order of precedence shall be the order in which the documents are listed below:

i) The Contract Agreement

ii) Letter of Award duly accepted by the Contractor together with its amendments, if any.

iii) Pre Award Minutes of Meeting, Resolutions to Deviations / Clarifications

iv) Pre-bid clarifications issued by the Owner and Amendments to Tender specifications

v) General Conditions, ITB, Special conditions for erection and Construction

vi) Technical Specifications

vii) Contractor's Bid Proposal

3.0 SCOPE OF WORK

3.1 The scope of work, if not otherwise mentioned in the Contract, shall be on the basis of a single Contractor's responsibility, completely covering all the equipment specified under the accompanying Technical Specifications. The Works include the following: -

a) Detailed design of all the equipment and sub-systems as per Specifications;

b) Complete manufacture of all the Equipment including shop assembly and testing as per Specifications, supply of special tools and tackles and services necessary for satisfactory execution of the Contract;

c) Providing Engineering Drawings, Data and operation manual, etc. for Owner's/Consultant's approval.

d) Packing and transportation of the Goods from the Manufacturer's Works to the Site including freight charges, insurance coverage;

e) Supply of Mandatory Spares;

f) Receipt, unloading, storage, preservation and conservation of the Goods at the Site;

g) Erection, Testing and Commissioning, trial run of all the equipment at the Site, Tests on Completion, putting into Commercial Operation;

h) i) Performance Guarantee Tests on successful completion of Reliability Run

ii) Reliability Test shall commence after completion of Commissioning of the Plant. Length of such operation shall be as specified in [VOL-IIA/S-10/Cl 2.02.02 PAGE 3] of the Contract.

i) Providing construction, erection, testing and commissioning supervision personnel to supervise the work, erection, testing and Commissioning of the Plant;

j) All civil works including supply of all materials and temporary works etc. as needed;

k) Structural work including supply of all materials, Consumables and temporary works etc. as needed;

l) Architectural works as approved by the Owner;

m) Providing three sets of as commissioned Drawings, three sets of as commissioned data/specification/parameter sheets duly signed by the relevant competent authority, and five sets of Compact disks (CDs) should be submitted prior to Take Over.

Provided that all Works shall be done as per the requirements of the Contract including, without limitation, the Drawings and Documents approved by the Owner and the Specifications.

Provided further that the Contractor shall, unless specifically excluded in the Contract, perform all such Work and/or supply all such items and materials not specifically mentioned in the Contract but are required for attaining Commercial Operation of the Plant as if such work and/or items and materials were expressly mentioned in the Contract and in a manner that ensures that the Plant is fit for the purpose intended.

3.2 **STANDARD OF CARE**

The Contractor shall execute and complete the Works in a safe, prudent and reliable manner in strict accordance with the Contract and with Good Engineering Practices.

4.0 **CONTRACT PRICE**

4.1 The Contract Price shall be for the entire scope of the Work with the breakdowns as specified in Schedule of Prices.

The Contract Price shall be lump-sum and firm, and valid for the entire period of the Contract.

4.2 The price for the Goods of origin outside India shall be the CIF Price.

4.3 **Taxes and Duties**

4.3.1 For the Goods of Indian origin, all Taxes shall be deemed to be included in the Contract Price. However excise duty, sales tax, works contract tax, octroi, and similar taxes as payable on finished goods and included in the Contract Price shall be indicated separately considering exemptions which may ordinarily be available/applicable at the prevailing structured rate. Further , Service Tax on Service portion of the Contract will be indicated separately. The normal prevailing rates of aforesaid taxes and duties and exemptions/concessions to the same with concessional rates shall be indicated. In case of delay in delivery not attributable to the Owner, any increase in the rates of aforesaid taxes beyond the scheduled date of delivery shall be to the Contractor's account. The amount of aforesaid taxes paid shall be reimbursed to the Contractor by the Owner upon presentation of documentary evidence upto the limit indicated in the bid offer.

4.3.2 The Taxes and Duties mentioned in Clause 4.3.1 for direct dispatch able items to Site from bidder's Sub Contractors, Sub Vendors , JV Companies whose works are located within India shall be reimbursed by the Owner upon presentation of documentary evidence upto the limit indicated in the bid offer.

4.3.3 In the case where Equipment have been listed under the schedule of items of foreign origin (to be imported) and such list have been accepted by the Owner, the responsibility of obtaining an import license, taking procedures thereon and payment of Taxes will rest with the Contractor though technically Owner will remain as an Importer. The Contractor shall prepare all required documents for

the Owner to make application for such import license and extend all possible assistance to the Owner for expeditious clearance of the license as and when requested by the Owner. The Contractor shall also arrange for payment of Taxes against any consignment on behalf of the Owner and the amount paid towards Taxes will be reimbursed by the Owner to the Contractor in Indian Rupee on presentation of documentary evidence as per Contract. In the case of delay in delivery not attributable to the Owner, any increase in the Taxes, port handling and port clearing charges as well burden due to rise in foreign exchange rate shall be to the Contractor's account.

The Bidder is to furnish a detailed list of imported equipment and materials and quantities against each item along with his Bid.

4.3.4 In the case of raw materials, components, sub-assemblies and other equipment and materials imported by the Indian Contractor for value addition, construction materials and Consumables, if any, all such import duties and levies payable shall be deemed to have been included in the Contract Price and no separate claim on this behalf will be entertained by the Owner.

4.3.5 Additionally, the Contractor shall bear and shall be liable for the payment of its Personal Taxes.

4.3.6 The Contractor and all its expatriate personnel shall be responsible for the timely and prompt filing of all returns, documents, estimates, accounts, information and details complete and accurate in all respects as may be required under the applicable laws/regulations of India by the appropriate authorities in India. In case the Contractor or any of its expatriate personnel do not comply with the above requirements, which results in any penalty, interest or other liability, the same shall be borne by the Contractor.

4.3.7 GSECL will arrange C Forms as applicable on quarterly basis. Also TDS certificate will be issued on quarterly basis.

4.3.8 Taxes and duties in the proposal shall be the rates prevailing fifteen (15) days prior to the date of opening of Techno Commercial Bid.

4.4 Price Adjustment for Quantity Variation in the Works and Change Order

4.4.1 Quantities of Equipment required by the Specification may be in certain cases, subject to variation pursuant to the Change Order in accordance with the procedure set out in this Clause 4.4.

4.4.2 Changes

(i) Owner shall have the right at any time by written notice to Contractor to make changes to the Work, whether such changes are modifications, alterations, deletions or additions. Contractor agrees to effect such changes in the Work as Owner may from time to time request subject to mutual agreement. The Change Order shall be limited within +/- 15% of Total Contract Price.

(ii) Any request by Owner for a change shall be delivered to Contractor in writing and shall be sufficiently definite and detailed to give Contractor an adequate basis on which to prepare a preliminary change order pursuant to Clause 4.4.3.

(iii) Upon receipt of Owner's request for a change, Contractor shall prepare a preliminary change order and deliver the same to Owner within ten (10) days time or any reasonable time mutually agreed following Contractor's receipt of such request.

(iv) Throughout the performance of the Works Contractor shall have a continuing obligation to suggest to Owner for Owner's consideration:

(a) All such changes as Contractor considers desirable; and

(b) Such other changes known to Contractor as may be necessary to incorporate significant new developments in technology which are applicable or appropriate to the Plant.

(c) Contractor shall submit any such suggestion in the form of a preliminary change order pursuant to Article 4.4.3.

4.4.3 Preliminary Change Orders

(i) Each preliminary change order submitted by Contractor to Owner pursuant to Clause 4.4.2 or any other express provision of the Contract shall be in writing and be accompanied by such information and data as will be reasonably required by Owner to evaluate properly the proposed execution of the work in question, the effect, if any, on the Work, scope of Work, an adjustment in one or more of the (i) Contract Price, (ii) Guaranteed Commercial Operation Date, (iii) Milestone Payment Schedule, (iv) any of the Performance Guarantees, or (v) any provision/scope of the Contract.

(ii) Owner shall reject or approve at its sole discretion each preliminary change order as expeditiously as proper consideration of the nature of the change may reasonably permit.

(iii) The cost of all work involved in preparing the information and data required to accompany the preliminary change order involved and for any additional analytical or investigative work requested by Owner in connection therewith is included in the Contract Price.

4.4.4 Change Orders

(i) Except as provided in Clause 4.4.5, Contractor shall not act upon any preliminary change order unless the Owner has executed a written Change Order.

(ii) Any adjustment of the Contract Price pursuant to the Change Order shall take into account, among other things, the elimination or avoidance of Work to be performed resulting from the changes in the Work and from assistance given by Owner.

4.4.5 Performance of Change Order pending agreement

If Owner and Contractor fail to agree on the effect of a Change Order and as a result a Change Order is not executed, Owner may nevertheless require Contractor to perform the Work as changed by delivering to Contractor a Change Order signed by Owner and Contractor shall complete all work specified in such Change Order and the dispute shall be resolved as provided in Clause 39: