NEYVELI LIGNITE CORPORATION LTD

2X500 MW NEW NEYVELI TPP

VOLUME II B & III

TECHNICAL SPECIFICATION
FOR
VENTILATION SYSTEM (SG-PACKAGE)

Specification No. PE-TS-400-553-A001 Rev 01

AUGUST 2015

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERIING MANAGEMENT
NEW DELHI

VOLUME – IIB

VOLUME-III

VOLUME II B

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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, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, Performance and guarantee testing / demonstration testing and handing over to BHEL's customer of **Ventilation SYSTEM** as per details in different sections / volumes of this specification and various pre award agreements for **2X500 NNTPP SG PACKAGE**.

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

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to 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 tems 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

SECTION: B

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

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SALIENT FEATURES OF THE SITE & GENERAL PROJECT INFORMATION

1.1 Introduction

The project site at Neyveli has distinct location advantages, being at pit-head distance from the source of lignite supply from Mines, making it convenient for transportation of lignite by belt conveyor. Water source is readily available from the nearby mines lake. Besides, other infrastructure such as access road, railway connection etc, already exist.

1.2 Power Plant Site

The power plant site is located at Neyveli, opposite to the now defunct Fertilizer and Briquetting & Carbonization Plant, near TPS-I Expansion and TPS-II.

1.3 Project & Site Information

(i).	Owner / Purchaser	:	Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli, Cuddalore District, Tamil Nadu State, India
(ii).	Consultant	:	Lahmeyer International (India) Pvt. Ltd (LII), Gurgaon, NCR, India.
(iii).	Project Title	:	2x500 MW Neyveli New Thermal Power Project (NNTPP)
(iv).	Location	:	200 kms south of Chennai and 50 kms south-west of Cuddalore
(v).	Latitude	:	11° 34′ 00″ N to 11° 35′ 00″ N
(vi).	Longitude	:	79° 26′ 00″ E to 79° 27′ 00″ E
(vii).	Elevation above MSL	:	(+) 67 m
(viii).	Nearest Railway Station	:	Neyveli,
(ix).	Nearest Sea Port	:	Chennai, at a distance of 200 km
(x).	Nearest Airport	:	Chennai, at a distance of 200 km
(xi).	Road Access/Approach to Site	:	Connected by Chennai-Thanjavur NH 45C road and state highway connecting Cuddalore – Virudhachalam via Neyveli. Both NH and state high way roads are well connected to NLC township roads. The approach road is approximately 15 kms from Chennai–Thanjavur NH – 45C road
(xii).	**Site Meteorological Data**		
	• Max ambient temperature	:	42.8° C
	• Min Ambient Temperature	:	26.9° C

• Wet bulb temp	:	29° C
• Max. Relative Humidity	:	92 % in the month of September
• Min. Relative Humidity		23 % in the month of May
• Rainfall		About 1265.7 mm annually (average)
• Wind direction		South West to North East direction
• Wind Speed		97.2 km/hr (maximum recorded) 4.3 km/hr (average wind speed)
• Seismicity		As per IS: 1893 (part 4) (Zone-II) Importance factor: 1.75.

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S.No	Description	SILL Value
	• RCC floors (Offices, laboratories, conference rooms and general floors)	5 kN/m^2
	• Balconies	5 kN/m^2
	• Chequered plate / gratings	5 kN/m^2
	• Walkways	3 kN/m^2
	• Toilets	2 kN/m^2

- In addition to LL, Hung loads for electrical, ventilation & air conditioning minimum of 0.5 kN/m^2 shall be considered.
- Load of 1 kN/m^2 shall be considered as hung load for piping unless otherwise mentioned. However, the actual loads will be as furnished by the supplier. The stringent most will be followed.
- For other areas LL shall be considered as per IS: 875 (Part-2).
- Ponding effects due to framing deflections for roofs, if any shall be considered.

(c) Seismic Load

The proposed plant is located in Seismic Zone-II as per IS: 1893, Seismic force on the structures will be considered accordingly.

(d) Wind Load

The proposed plant is located in Wind Speed Zone of 50 m/s as per IS: 875 (Part 3). The wind force on the structures will be considered as follows:

Table 2.3
Wind Speeds

Description	Wind Speed
Basic Wind Speed Vb (at 10m above mean ground level)	50 m/sec
Risk coefficient K1 (for 100 years)	1.07
Category of terrain	Category 1
Factor K2	As per IS: 875
Topography factor K3	As per IS: 875

For the design of structures, wind force on Equipment, supported on frame including all fixtures, piping, staircase, ladder, etc, shall be considered.

Design of structures shall be checked for the condition of wind load with gust factor.

(e) Earth Pressure Loads

For earth pressure the worst condition with dry / submerged and active, passive or at rest shall be considered. The pressure coefficient shall be adopted as recommended in Soil Report or for the backfill material used.

(f) Temperature Loads

The total temperature variation shall be considered as 2/3rd of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the average between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50 % of the total considered temperature variation with temperature load applied with positive and negative sense.

For design purpose average maximum annual variation shall be taken as +50°C to +5°C.

Coefficient of thermal expansion of steel shall be taken as per IS: 800 where the value is given as 12x10-6/°C. Coefficient for thermal expansion for concrete shall be taken as per IS: 456.

(g) Thermal Loads (during operating condition)

When thermal loads (such as produced by temperature changes in piping, equipment and structures) results in friction between equipment and supports (exchangers) or piping and supports, the friction force will be taken as the operating load on the support multiplied by the applicable friction coefficient given below:

Table 2.4
Thermal Loads

Description	Value
Surfaces	Friction coefficient
Rolling supports	0.05
Steel to steel	0.30 (longitudinal) and 0.10 (lateral)
Concrete to steel	0.30

(h) Equipment Loads

Static and dynamic loads of major equipments shall be based on the manufacturer's data of the specified equipments and shall be considered in design in addition to the live load. However, where the uniform floor live load adequately accounts for the equipment moving weight, the weight of such equipment as a dead load shall not be considered e.g. control room floors are usually designed for a live load that includes the equipment weight also.

All equipments, tanks and piping design loading shall include hydraulic test loading. Weight of equipments, ducts, tanks, pipes, conduits, etc. supported by structure shall include maximum possible loading conditions i.e. flooded conditions and associated impacts, test loading, anchorages and constraint effects.

Air and gas duct loads shall include weight of insulation, duct attachments, dust accumulation loads, seismic, wind and other loads applicable.

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(i) **Hoists, Monorail and Elevator loads**

All lifting beams and monorails shall have their design loads increased for impact factor. Loads for hoists, monorails and elevators shall be taken as per IS: 875.

100 % of the lifted load including elevator live load plus the cab weight shall be considered for the elevator support beam design. Pedestals in elevator pits shall be designed assuming 100 % impact factor.

(j) **Vibration and Noise**

The design shall ensure that vibrations from any moving machinery transmitted from its immediate foundations to adjacent buildings or areas of the same building shall be suppressed in accordance with the recommendations of relevant codes of practice. Any control room, administration facility and other permanently occupied office area shall be structurally isolated from plant areas subject to frequent shock loads or containing large oscillating or rotating plant and equipment.

(k) **Other Loads**

- Stresses imparted to structures due to differential settlements, variation of water table, erection and maintenance loads, creep and shrinkage shall also be considered in design of all structures.
- Dust loads

  All buildings / structures shall be designed for a dust load of 1 kN/m^2 for flat roof and 0.5 kN/m^2 for sloped roof.
- Construction Loads

  The integrity of the structures shall be maintained without use of temporary framing struts or ties and cable bracing as far as possible. However, construction or access considerations may dictate the use of temporary structural systems. Special studies shall be made and documented to ensure the stability and integrity of the structures during any periods involving use of temporary bracing systems.
- Future Loads

  Loads from future expansion shall be considered when so directed by the Owner/Consultant. Future loads may include any of the loads listed above.
- Surge Loads

  Surge loads may occur in some vessels or equipment. In such cases, the magnitude and direction of the load shall be given by the equipment supplier.

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SECTION: C

TECHNICAL SPECIFICATIONS

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SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1. FUNCTION

The purpose of the system is to provide Ventilation System for different areas of 2 x 500 MW, NNTPP- SG PACKAGE under the scope of BHEL.

2. SYSTEM DESCRIPTION

2.1. The Ventilation System is provided in the following locations within the ESP control room bld. by UAF.

2.2. Area to be ventilated are as under:-

a) MCC/Switchgear Rooms of ESP bld.

b) Electrical room, Cable Galleries and other room.

Ventilation provision for Auxiliary Buildings in various location (offsite area) shall be as under:

Sl. No.	Area	Type of ventilation
a	Fuel oil pump house	Mechanical Exhaust fans
b	Compressor room	Mechanical Exhaust fans
c	Bunker bay building	Mechanical Exhaust fans
d	AC plant room	Mechanical Exhaust fans
e	Chemical feed station	Mechanical Exhaust fans
f	Store and toilets	Mechanical Exhaust fans

NOTE: - Mechanical ventilation for other auxiliary buildings under BHEL scope, shall also be provided.

Please refer to clause **12.5** and other relevant clauses of customer technical specification **section C-2** for other detail of system description.

2.3. The washed air supplied to MCC / Switchgear/ Cable galleries shall be exhausted to atmosphere through gravity dampers.

3. DESIGN CRITERIA

3.1. System Design Criteria

The outside design conditions considered are as follows:

	Summer	Monsoon	Winter
DBT (°C)	43.0	31.1	10
WBT (°C)	25.6	26.6	6.1

The inside design conditions:-

Evaporative Cooled Areas:-

Average Inside temperature shall be kept below the design ambient temperature during summer (3^0 C below ambient temperature).

Mechanically ventilated areas:-

Average Temperature rise above outside ambient shall be maximum 5^0 C during summer.

Higher number of air changes/higher quantity of airflow of either of condition shall be selected.

No. of air changes per hour shall be as follows: -

Sl. No	Area	No. of Air changes/hour
1	ESP building (for evaporative cooling).	8
2	Switch gear rooms (for evaporative cooling).	10
3	Cable galleries (for evaporative cooling).	6
4	Fuel oil pump house, Compressor room, Bunker bay building, AC plant room, Chemical feed station, Store and toilets (for mechanical ventilation).	20

All equipment shall be designed for continuous duty.

The ducting shall be sized to have constant friction drop along its length with air velocity in the ducts normally not exceeding 10 m/sec

For other information please Refer clauses 12.6 of section C-2 and other relevant clause under section C-2 (customer specification).

4. LAYOUT CONSIDERATIONS

4.1 The supply air quantity for each unit shall be supplied from one (1) UAF of 75000 CMH capacity, placed at the roof of ESP control room building.

4.2 The UAF primarily serve ESP building and the electrical areas like MCC Room, Switchgear Room, Cable galleries. The washed air supplied to MCC / Switchgear/ Cable galleries shall be exhausted to atmosphere through gravity dampers. Fire dampers shall be provided in the supply air ducting leading to all electrical rooms

5. EQUIPMENT AND SERVICES TO BE PROVIDED FOR VENTILATION SYSTEM

5.1. UAF

Each UAF unit shall comprises of:

a) Please refer clause nos. 12.7.3, 12.7.4, 12.7.5 of section C-2 and other relevant clause of customer specification section C-2.
b) One (1) No. (100% duty) Centrifugal fan backward inclined, SISW type, complete with electric drive motor, drive Pulleys, V-belt, belt guards, slide rails and other accessories etc.
c) Two (2) Nos. (2 x100 % duty) Centrifugal split casing type pumps for circulation of water. Pump system shall be provided with pot strainer with by-pass valves, inlet and outlet pressure gauge.
d) A spray nozzle system consisting of single bank spray system connected to header, flow regulating valves for controlling flow to spray header. Nozzles shall be of Brass or Gun metal with chrome plating and self-cleaning type.
e) Pressure drop through the nozzles shall be in the range of 1.4 to 2.4 Kg/cm2.
f) Distribution plate, Moisture eliminators of frpi/pvc,
g) UAF chamber shall be fabricated from 5 mm MS sheet.
h) Water tank of minimum 6 mm thick
i) Intake louver with frame & screen
j) All valves, pipes, nuts & bolts, pipe hangers, supports, internal fittings and supports including ball float valves for makeup water connection.
k) Drain pipe with siphon, marine light
l) Volume control dampers (VCD)
m) Metallic type water flooded filter
n) Individual inspection door with ladder and cat walk is to be provided for different section of the air washer unit, marine light (2 Nos.) in each section.
o) Low Level switch for Air washer sump.
p) Suction screen shall be online replaceable type.
q) The distribution plate shall be fabricated out of 18G galvanized steel sheets & galvanized steel angle supports with minimum 50% free area.
r) Inter connecting GI piping between centrifugal pump sets and air washer unit spray headers/ sump, with necessary supports and supporting structure.
s) Efficiency of centrifugal fan and pump shall not be less than 70%.
t) Electrical feeder suitable for following motor rating shall be provided for Air washer equipment. Vendor to ensure that motor rating for air washer fan and pump shall be as mentioned below.

Sr. no.	Items	Motor rating (Kw)
1.	Centrifugal fan (75000 CMH / 50 mmWC SP)	18.5
2.	Centrifugal pump (75 CMH / 30 m head) (min.)	11

5.2. Centrifugal flow fan units

Each centrifugal fan shall be complete with:

a) The casing shall be of welded construction fabricated with heavy gauge galvanized sheet steel or MS sheet with spray galvanization (upto 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.

The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non-overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts.

The first critical speed of the rotating assembly shall be at least 25% above the opening speed.

The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive.

b) Please Refer clause no 12.7.16 of section C-2 and other relevant clauses of section C-2 (customer specification).

c) Removable drain plug with fan casing.

These fans shall cater to the areas as indicated in the fan schedule of ventilation system.

5.3. Wall mounted axial flow fan

Each wall mounted axial flow fan shall be complete with

a) These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design. Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided.

The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1400 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1440 rpm for fan with impeller diameter of above 450 mm and 2800 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed.

b) Please Refer clause no 12.7.18 of section C-2 and other relevant clauses of section C-2 (customer specification).

c) Damper, vibration isolators, nuts and bolts, back draft dampers etc. Shall be provided.

These fans shall cater to the areas as indicated in the fan schedule of ventilation system.

5.4. ROOF EXTRACTOR UNIT:

Each roof extractor unit shall be complete with:

The roof extractors shall be “COWL” type.

Impeller shall be of axial flow type, cast Aluminium in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above and the same shall be spray or hot dip galvanised. In casing, access door with locking arrangement be provided.

The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanised bird screen of 15 mm Square be provided with the cowl. All accessories, steel supports as required shall be provided. All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.

These fans shall cater to the areas as indicated in the fan schedule of ventilation system.

5.5. All supply / Exhaust Air ducting:

a) Galvanized steel sheet (class 275 gm/ sq.M as per IS: 277).

b) Thickness of GI duct shall be minimum 1 mm.

5.6. Insulation:

Thermal insulation shall be provided for the duct exposed to sun / rain only.

All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products or Equivalent) be applied @ 1.5 Kg /Sqm on the surface.

Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber or Equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen.

Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side.

Please Refer clause no 12.7.12 and 12.7.13 of section C-2 and other relevant clauses of section C-2 (customer specification).

5.7. WATER PUMP SETS

Centrifugal pump Horizontal split casing type of adequate capacity to match the system requirement for UAF spraying arrangement.

Each circulating water pump set for UAF shall comprise of the following:-

a) One no. adequately sized TEFC sq. cage induction motor suitable for 415V, 3 phase, 50 Hz AC supply.
b) One no. Pot type strainer at inlet complete with screen, drain arrangement etc.
c) 150 mm dia. Dial Type pressure gauges one each at suction & discharge side of the pump set.

d) One no. non-return (check) valve at discharge side of pump set.
e) One set of base plate, coupling, coupling guard, anti-vibration mountings, foundation bolts etc.
f) Rain protection canopy for the pumps and motors, if located at outdoor shall be provided.
g) For other information please Refer clause no 12.7.9 of section C-2 and other relevant clauses of section C-2 (customer specification).

5.8. Diffusers & grills

a) Manually adjustable/back draft type/Gravity type exhaust air dampers.
b) Please Refer clause no 12.7.22 and 12.7.27 of section C-2 and other relevant clauses of section C-2 (customer specification).

5.9. Piping and fittings:-

Detail	Description
Circulating water piping of Ventilation System	Heavy grade-IS: 1239 or Equivalentupto150 NB or Equivalent and IS: 3589 or Equivalent for pipes beyond 200 NB. The piping upto 100 mm diameter shall be of galvanized steel and those above 100 mm dia shall be black steel. The piping shall be adequately supported.
Drain piping Fittings	Same as above & galvanized as per IS:4736 1. The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above. 2. For sizes 50 NB and below, the material shall conform to ASTM A-105 3. All steel flanges shall be of slip on type and shall conform to ANSI B 16.5 4. For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS: 2633/BS: 534. 5. Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSIB31.5
Steam piping / spray piping /fitting	1. Seamless Carbon steel pipe conforming to ASTM-106 Gr B shall be used. Steam pipe line shall be provided with necessary steam traps, vents and drain connections. 2. All pipe fittings shall be seamless construction (forged) as per ASTM A 105. 3. Necessary hangers, supports and auxiliary structures for pipe supports shall also be provided by the Bidder. 4. It is the sole responsibility of the Bidder to obtain

	clearance from IBR for the design, manufacture, erection and testing of pipes, valves, fittings, specialties etc. In order to obtain the above approvals, all necessary documentation etc. required to be furnished/arranged shall be done by the Bidder. 5. In order to take care of thermal movement, due to the temperature of the fluid being handled, loops in vertical or horizontal plane may be provided to make the system flexible. However, in no case a U-type should be provided in the vertical plane. Further, the supporting system on this line should be such that it does not arrest the free movement of the pipe

5.10. Valves:-

- Valves shall have full sizes port and suitable for horizontal and as well as vertical installation. Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.
- Gate, Globe and stop check valves shall have bonnet back seat to facilitate easy replacement of packing with the valves in service.
- All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
- Manual gear operators be provided for valves of size 200 NB and above.
- All valves with rising stem shall have position indicators. All valves shall be provided with locking arrangement.
- All water line valves shall be of Cast Iron body for sizes 65 NB and above conforming to IS: 14846 and Gun Metal construction for sizes less than 65NB conforming to IS:778. Cast Iron parts shall conform to IS: 210 Gr. FG 220. However, butterfly valves shall confirm to latest revision of BS: 5155 or equivalent standard of required class/rating.

5.11. CONTROL PHILOSOPHY

a) Remote I/O Panel for Air-washer:-

The Control system shall comprise of PLC based control panel, common for both AC & Ventilation system, kept in AC plant room and shall be supplied by AC-Plant supplier (AC Bidder's scope) with remote I/O panel for four (4) nos. air-washers room in power house bldg. and two (2) nos. remote I/O panel for UAF of ESP control room, hook-up with, OPC compliant (Data Access 2.0) TCP/IP on Fiber Optic link to main plant DCS for monitoring. Remote I/O panel for Air-washer and UAF have been excluded from the scope of ventilation package and is included as part of supply from the AC Plant supplier.

The communication cable between PLC to remote I/O rack shall be hot-redundant armoured cable. However, all local instruments for operation & control monitoring of ventilation system are within scope of ventilation system supplier.

The water sump of each Unitary Air Filtration Units shall be provided with a low level switch which will initiate an alarm and will trip the pump sets, in case the water level falls below the predetermined level.

At the delivery pipe of each pump, a pressure switch will be provided along with the pressure indicator.

Relative Humidity inside the ventilated areas shall be displayed digitally on the local control panel Individual Fan Running / stop Indications should be provided Individual Pump Running /Stop indications for both spray pumps and cell deck pumps should be provided.

Following Audio-Visual Annunciations are to be provided for Air-washers and UAFs.

1. Motor Overload Centrifugal Fan
2. Motor Overload Pump - 1
3. Motor Overload Pump - 2
4. Fan Running.
5. Fan Stop.
6. Pump – 1 Running.
7. Pump – 1 Stop.
8. Pump – 2 Running.
9. Pump – 2 Stop.
10. RH high
11. RH low

b) HUMIDITY CONTROL

To protect the equipment located in the ventilated space from effects of high humidity, control device using Humidistat interlocked with the Pump Motor of the Fill Section shall be used in the electrical areas. Humidity beyond 60% RH in these ventilated space shall automatically trip the respective UAF pump for fill section only. The pump may be restarted automatically at about 50% RH.

At least two (2) nos. Humidistat (RH High and Low) shall be provided for each UAF Unit. However, manual over riding facility shall be provided for humidistat controlled Pump sets of the UAF.

c) Fire damper:

Motorized type electrically operated fire dampers shall be provided in the ventilation supply air ducting/ fans leading to electrical rooms like various MCC rooms, switchgear rooms, cable spreader rooms and in the exhaust path of oil room and oil tank area. These dampers shall be operated with the help of signal from smoke detectors/ thermal sensors (These automatic dampers shall be interlocked suitably with fire alarm system and shall also possible from control panel room remote location). Motors shall remain energized in the normal condition to effect opening of dampers. In the event of fire, the motors shall be de-energized and the damper shall close due to spring action.

d) OTHER CONTROLS - VENTILATION SYSTEM

ON/OFF controls of each drive and equipment like UAF pumps, UAF fans etc located in UAF room shall be provided in local I/O panel located in UAF room. ON/OFF indication shall also be provided on this panel. Emergency stop push button shall be provided for all drives in UAF rooms. UAF pumps shall be interlocked with Humidistat. All other drives associated with ventilation system like fresh air supply fans, exhaust fans, roof extractor etc. shall be fed from respective MCC.

6. SPECIFIC REQUIREMENTS:-

RE / wall mounted fans shall be selected so as to have motor rating and wall / slab opening as under. Feeder suitable for following ratings only shall be provided by BHEL.

1.	Roof extractor units with 15 mmwc static pressure.		
	Capacity	Motor rating	Roof / Slab opening
a.	50,000 CMH	5.5 KW	1320mm
b.	40,000 CMH	5.5 KW	1320mm
c.	20,000 CMH	2.2 KW	1140mm
2	Axial flow supply fans with 30 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	2.2 KW	800mmx800mm
b.	7,500 CMH	1.5 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	500mmx500mm
3	Axial flow supply fans with 20 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	1.5 KW	800mmx800mm
b.	7,500 CMH	1.1 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	600mmx600mm
4	Axial flow exhaust fans (Bifurcated type) with 15 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	2.2 KW	900mmx900mm
b.	10,000 CMH	1.5 KW	800mmx800mm
c.	7,500 CMH	1.1 KW	700mmx700mm

d.	2,000 CMH	0.55 KW	500mmx500mm
5	Axial flow exhaust fans with 10 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	1.1 KW	900mmx900mm
b.	10,000 CMH	0.75 KW	800mmx800mm
c.	7,500 CMH	0.55 KW	700mmx700mm
d.	6,000 CMH	0.55 KW	600mmx600mm
e.	2,000 CMH	0.37 KW	500mmx500mm
6	Exhaust fan (propeller type) with 5 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	1200 CMH	100 W	300 mm circular

7. MATERIALS OF CONSTRUCTION

7.1. CENTRIFUGAL FAN

Impeller hub: Mild Steel

Impeller back plate blade & shroud: Mild Steel to IS: 2062 Gr.B.

Shaft: EN - 8 or eqv.

Shaft sleeve: EN - 8 or eqv.

Flexible connection at outlet/inlet: Fire resistant type plastic impregnated canvas with M.S. flange and cleats (3 mm thick).

V Belt (matched sets): ISI marked (Reinforced rubber section to (IS: 4776)

Bolts & nuts: Galvanized / MS (Epoxy painted).

Vibration isolating cushy foot mountings, foundation bolts and nuts etc.

The casing shall be of welded construction fabricated with heavy gauge galvanized sheet steel or MS sheet with spray galvanization (upto 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.

The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts.

The first critical speed of the rotating assembly shall be at least 25% above the opening speed.

The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive.

7.2. AXIAL FAN

Casing : M.S. sheet – 3 mm thk for fan dia upto 750 mm 5mm thick for fan dia of 750 mm and above as per IS:1079 / IS:2062 Gr.B

Hub: As per manufacturer std. (AL- LM6)

Neoprene rubber pads: As required.

Supporting frame for mounting: Required.

Protective screen at inlet: Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh).

Mounting flange on casing: At inlet and outlet.

Painting / protecting coating – All the MS parts shall be galvanised or protected with three coats of epoxy paint.

All supply air axial flow fans shall be provided with pre-filters (and also fine filters for MCC/switchgear room).

Please refer to clauses no 12.7.18 of section C-2 with other relevant clauses of Customer technical specification section C-2

7.3.

Casing/cowl/hood: (Spray / hot galvanised M.S. Sheet to IS: 2062 Gr.B (Short duct casing).

7.4. UAF

Moisture Eliminators plates: 100% virgin PVC die-extruded construction of minimum finished thickness of 2 mm.

Moisture Eliminator Frame: 22 SWG GI sheets and GI angle of adequate strength.

Tank: Min depth -600mm

Piping: MS Heavy class (Galvanized) to IS: 1239 Part I or IS: 3589 depending on size.

Suction Screen for Water: Brass (40 mesh size 2 nos for each air washer)

7.5. Air Filters

PRE FILTER

a) Filter Media: Fibrous material (extruded polyethylene): Dry types with element of 5 ply construction for fabric type.
Efficiency: Average arrestance of 65-80% when tested in accordance with BS: 6540 / ASHRAE – 52-76.
Allowable pressure drop: Initial pressure drop – Not to exceed 5.0 mm WC at rated flow.
Final pressure drops- Up to 7.5 mm WC.
Frame Work 18 G GSS.
Filter mounting frame shall be GI angle iron frame of adequate thickness.
Size – 610 x 610 mm (Approx.)

b) Washable SS FILTER (for Air washer / UAF units)
The filters shall be washable/cleanable type construction of SS 316 wire netting with three or more layers of wire mesh of different mesh sizes stitched together and held in a SS / Al frame of adequate thickness but not less than 18 SWG for Al and 20 SWG for SS suitable for long use in an industrial plant. The filter when flooded shall have a filtration efficiency of 90% down to 10 microns.
The filter mat shall be weaved with SS wire of 0.16mm diameter providing an aperture of max 0.025mm
Please refer to clauses no 12.7.17 of section C-2 with other relevant clauses of Customer technical specification section C-2.

FINE FILTER

Filter Media: microvee type
Efficiency: Average arrestance of 80-90% when tested in accordance with BS: 6540 / ASHRAE – 52-76
Frame Work: 16 G Aluminium alloy.

7.6. CENTRIFUGAL PUMP

Impeller: Bronze as per Grade IS: 318 Grade 2
Casing: 2% Ni Cast iron to IS: 210 GR. FG-260.
Wearing ring: Bronze Grade IS: 318 GR-2.
Shaft Sleeve: SS 316.
Base plate: Carbon steel as per the IS-2062 Gr.B.
Bolt and nuts: M.S. (Epoxy painted / Galvanised).
Type of seal: Mechanical
Pump motor coupling: Pin & bush type.
Shaft seal: Mechanical seal
Please refer to clauses no 12.7.19 with other relevant clauses of Customer technical specification section C-2.

8. GENERAL

1) Basis of design, all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc. Are subject to Customer approval during detail engineering stage.

2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.

3) Vendor to include the Back wash arrangement of pot strainer with gate valve, piping etc for the Air Washer.

4) Vendor to include level gauge & level switch for each Air-washer tank for alarm & trip of the pumps. Also include one no. Pressure switch for each air washer pump.

5) All drawings and documents shall be computer based.

6) All commissioning spares & consumables for trouble free operation shall be provided.

7) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.

8) Indicative list of makes is enclosed as per Annexure-I however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.

9) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.

10) Fixing frame works for diffusers and grilles in the scope of Vendor.

11) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.

12) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.

13) Drain piping within room up to the drain point to be provided by the Vendor.

14) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.

15) The tools and machine required for erection of equipment shall be arranged by Vendor.

16) Tools & tackles as required for regular maintenance shall be supplied by Vendor.

17) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.

18) Instrument for testing shall be calibrated by Ventilation plant supplier before taking up testing.

19) Temperature gauges shall be provided with thermo wells and fixing arrangement.

20) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.

21) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.

22) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.

23) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.

24) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of ventilation system.

- Design dry bulb temperature and relative humidity of conditioned air, Auxiliary power consumption, Vibration and noise level etc.
- Performance test of the Ventilation system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours in summer or monsoon and 24 continuous hours in winter. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.
- All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provide free of cost which are categorically listed in the Electrical scope sheet of technical specification.

25) Motorized fire damper will be installed at supply air duct in electrical areas like MCC / Switchgear room / cable spreader room etc. in power house building and ESP building. Fire damper will close on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Also respective Air washers / UAFs shall trip on receiving fire signal from fire protection system.

26) Vendor to furnish drawings / documents as per the drgs. /documents submission schedule given in the contract.

27) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.

28) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis enclosed.

29) The bidder's proposal shall be for equipment in accordance with the Tech. Specification.

30) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements.

31) Bidder should suitably group the signals coming from various instrument etc. and the same shall terminate in local JB, from Local JB common cable to PLC / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provided free of cost which are categorically listed in the Electrical scope sheet of technical specification.

32) Feeder for a combination of fire dampers / valves etc. shall be derived from respective control panel by bidder. Distribution through junction box / distribution board shall be in bidders' scope and shall have provision for isolation of individual fire damper / valves. Suitable transformer shall be provided by bidder (if required) to derive the power input.

33) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.

34) Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.

35) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.

36) The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.

37) All openings required in brick wall for installing the axial supply and exhaust fans, propeller fans, duct opening, louvers and damper openings etc. shall be done by vendor. Grouting of fans along with anchor fasteners shall also be done by vendor. The openings shall be finished properly. In case openings are done once the wall have been painted, repainting, to match with the existing wall paint shall also be done by the vendor. Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Ventilation system vendor.

38) Flat, platform type RCC / PCC foundation shall be provided for installing Air washer / Centrifugal fans,UAF and UAF fan / pumps etc. Vendor shall fix the equipment using proper anchor fasteners to secure the equipment and obtain parameter related to vibration and noise.

39) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.

40) All codes and standards shall be as per contract specifications

9. EXCLUSIONS

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

a) Construction of Air washer plant room, foundations for Ventilation equipments (air washer, centrifugal fan, RE Unit only).
b) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers.
c) Provision of drain traps / points,
d) For Electrical scope, refer Electrical scope matrix sheet.
e) Lighting of Air washer plant rooms /areas
f) Lifting & handling arrangement in Air washer plant for maintenance purpose.
g) Structure for running the ventilation ducting header outside 'A'- Row, however required inputs shall be provided by the vendor.

SECTION: C 2

CUSTOMER SPECIFICATIONS

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SECTION: C 2A

CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT

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VOLUME – II A

SECTION – XII

AC & VENTILATION SYSTEM

TABLE OF CONTENTS

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12.1 General

Ventilation and air conditioning facilities will be provided for the various plant premises to ensure proper working environment both for men and machine and to maintain necessary environmental conditions for proper storage of plant, equipment and materials.

This specification will be read in conjunction with other parts / volumes (Vol. I, , II, , III, IV, V, VI & VII of the NTA1-SG portion) of the specification where other related project requirements have been given.

The intent of specification is to cover provision of ventilation and air conditioning facilities including all accessories for steam generator package on turnkey basis for 2 x 500 MW power plant at Neyveli Tamilnadu, India, as per the detailed scope of work described in clause 12.3.

12.2 Codes & Standards

All equipment, systems and works covered under this specification will comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed and the following publications, norms / guidelines, standards, acts and rules.

- Publications of Bureau of Indian Standards (BIS).
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
- American Conference of Governmental Industrial Hygienists (ACGIH) publications, U.S.A.
- American Refrigeration Industries (ARI).
- Publications of International Standards Organisation (ISO).
- VDI stipulation for vibration level.
- Handbook of Air Conditioning System Design by 'Carrier Air Conditioning Company'

The following codes & standard will be followed:

- IS: 226 Specification for structural steel (standard quality)
- IS: 655 Specification for metal air duct.
- IS : 277 Specification for galvanised steel sheets
- SMACNA Sheet Metal and Air Conditioning Contractors National Association

The list furnished for standards and norms may not cover certain aspects or products. In such cases, where norms / standards / guidelines other than those listed above are followed, the contractor will furnish a copy of such document (s) in support for the purchaser's perusal and acceptance of this project. Whenever a contradiction is found between the different documents being followed the decision of the purchaser will be final and binding.

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Metric system of units will be followed in design, manufacture and supply of all units. Name plates of equipment as well as operating / maintenance instructions will be in English language.

Noise level generated by the equipment supplied will not exceed the permissible limit of 65 dB (A) within the air conditioned served premises. In the air conditioning and ventilation plant room maximum allowable noise level will be 85 dB (A) at a distance of 1m from equipment.

The Contractor will also provide air conditioning and ventilation facilities to any other areas / technological system if envisaged besides those mentioned in this specification by the Contractor this stage or during detail engineering.

The air conditioning and ventilation equipment will be heavy duty type suitable for continuous operation under industrial duty conditions throughout the year.

12.3 Detailed Scope of Work

The scope of work covers the complete equipment / system design, engineering, manufacture / procurement, assembly, shop testing, shop painting, packing, transportation to site, unloading & storage at site, erection, supervision, site painting, testing, commissioning and conducting performance guarantee tests of all the ventilation & air conditioning systems including ducting, piping, dampers, valves, insulation, supports, measuring & control instruments etc.

The service facilities like civil, structural, electrics, illumination, instrumentation, water supply & drainage and handling & hoisting facilities needed for the ventilation and air conditioning systems will be included in the Contractor's scope of work.

Providing first charge of consumables like oil, grease, refrigerant etc. as required till successful completion of trial operation. The quantity and specification of such consumables will be indicated.

Supply of commissioning spares as may be required during erection, start up and initial operation of all the units / systems till successful completion of commissioning. The price for the commissioning spares will be deemed to be included in the contract price for the system.

Supply of tools & tackles required for maintenance of air conditioning and ventilation systems.

12.4 Performance Requirement

All equipment will be designed / selected such that the duty requirements as indicated in this specification can be maintained.

12.5 Inside design conditions

The following inside design conditions will be maintained in the various premises.

Sl.No	Premises	Inside dry bulb temp. °C	Relative Humidity %
1.	ESP Control rooms which also houses variable frequency drive panels of ID fans and other rooms need air conditioning	23 ± 1°C	55 ± 5%
2.	Central emission monitoring system room (CEMS), thyristor room(if applicable) for coal feeder drives	25°C (Max.)	-
3.	Shift In-charge rooms in ESP control room building, elevator machine rooms.	25°C (Max.)	
4.	MCC / Switch gear room, Electrical room, cable gallery and other rooms need supply air ventilation system	3°C above ambient temperature with pressurisation 2 – 3 mmWC	
5.	Fuel oil pump house, air compressor room, bunker bay building, AC plant rooms, chemical feed station, stores and toilets	Exhaust / general air exchange ventilation	

12.6 Design Criteria

The selection / design and manufacture of plant and equipment will be suitable for the intended service and the atmospheric / environmental conditions prevailing at the plant site.

The air conditioning and ventilation systems will include fan, dry panel type air filter, air conditioning unit, duct work, air supply grills, return air grills, dampers, insulation, piping, electrics, instrumentation and controls etc.

The following air velocities will be considered for the ventilation and air conditioning systems. However, standard sizes of equipment and accessories will be adopted satisfying the following limiting conditions.

- Louvers for air inlet - 1.5m/sec (max.)
- Dry panel filter (Face velocity) - 2.0 m/sec (max.)
- Main ducts (Ventilation) - 8 – 10 m/sec
- Main ducts (Air conditioning) - 6 – 8 m/sec

- Branch duct (Ventilation) - 6 – 8 m/sec
- Branch duct (air conditioning) - 4 – 6 m/sec
- Air supply grills - 3 – 4 m/sec
- Return air grills - 2 – 3 m/sec
- Centrifugal fan at inlet/outlet - 8 – 10 m/sec
- Water velocity in piping - 1.5m/sec. (max.)

Air conditioning and ventilation equipment will be located in a separate plant rooms. The plant rooms will be provided with separate approach, fire fighting and handling & hoisting facilities by the Contractor. The equipment will have at least 10% reserve capacity. Design calculations will be submitted for selection of system capacity as well as equipment selection. Air conditioning and ventilation systems will be designed considering the fire safety norms and will be interlocked with the fire detection system of the plant.

Central air conditioning system with chilled water based (vapor compression type) will be provided for ESP control rooms which also houses variable frequency drive panels of ID fans, Shift in charge rooms and other rooms require air conditioning facilities. Under deck insulation will be provided for all exposed roofs in the air-conditioned premises.

Chilled water expansion cum make up tank of adequate capacity will be provided at the highest point in the chilled water circuit. The tank will be complete with all accessories like float valve, limit switch with level indicator quick fill, drain, over flow etc. The tank will be thermally insulated.

Window type room air conditioner / Split type air conditioner will be used for air conditioning of the rooms for CEMS, thyristor room (if applicable) for lignite feeder drives and other small rooms located in far away from chilled water plant.

MCC / switch gear room, electrical room, cable gallery and other rooms require fresh air ventilation will be provided with fresh filtered air supply system. The rooms will be pressurized to 2 – 3 mmWC to prevent dust ingress by providing wall mounted gravity dampers.

Fuel oil pump house, air compressor room, bunker bay building, elevator machine rooms, AC plant rooms, chemical feed station, stores, toilet and other rooms generating fumes / heat will be provided with pressurized ventilation exhaust ventilation by installing wall mounted axial flow fan.

12.7 Type and Rating Of Equipment

Equipment Selection Criteria

12.7.1 Air conditioning systems

Air conditioning systems for ESP control room buildings of steam generation unit-I and unit-II will be provided. Common AC plant (if applicable) for ESP control rooms of unit 1 & 2 with 2 nos. screw chillers (1 W + 1 SB). Common AC plant

will be located in ESP building of Unit – 1. The contractor will do the design calculation of their own and furnish to the Owner/Consultant for approval for finalization of the system.

Chilled Water Plant for Air Conditioning System

The chilled water plant (for each ESP control room building) will include

Common AC plant for ESP control room unit 1 & 2 with:

a) 2 nos. screw chillers (1 W + 1 SB)
b) Chilled water pumps, 2 Nos. (1W+1R)
c) Condenser water pumps, 2 Nos. (1W+1R)
d) AHUs with accessories, 3 Nos (2W+1R)
e) Fan coil units for shift in charge room, quantity as per requirement.
f) Cooling tower with accessories – 2 Nos (1W + 1S).
g) Chilled water and condenser water piping with valves, pressure gauge, strainer etc.
h) Flow components in pipe lines
i) Thermal insulation of chilled water pipelines.
j) Humidity control arrangement with strip heater and pan humidifier
k) Refrigerant piping, valves and fittings
l) Ducting network with damper, supply air diffuser, return air grills, acoustic and thermal insulation.
m) Make up air filter with damper in different AHU rooms.
n) Insulated expansion tank. Tank will be located at the top most location of the entire chilled water piping network.
o) MCC, starter panel, electrics, instrumentation & controls etc.

Vapor compression machine with screw chiller will be chosen not only to ensure chilled water supply but also to perform efficiently at lower loads and at lower condenser water inlet temperature (particularly during winter season). If needed condenser water temperature control will be provided.

In general effort will be made for connecting the return air path from the control rooms in the gap between the roof and false ceiling and led back to the AHUs. Necessary duct line thermal and acoustic insulation will be provided as required.

Contractor will furnish the capacity range & inlet condenser water temperature range for their machines.

The Vapor compression machine with screw chiller and all pump sets will be installed in the AC plant room and various AHUs in AHU rooms to be located near / adjacent to the served premises.

Central emission monitoring system room (CEMS) & small rooms far away from chilled water plant will be air conditioned by providing suitable Split / window type air conditioner.

The cooling capacity of air conditioning system will be decided on the basis of heat dissipated in the premises, building heat radiation, illumination heat, occupancy heat, make up air heat etc. in the premises. Fresh air quantity will be based on 1.5 air changes / hour. The system will have at least 10% reserve capacity.

The air conditioning system will be provided with heating coil & humidifier for winter heating & humidity control.

12.7.2 Ventilation systems

Unitary Air Filtration (UAF) Unit for SG area (If applicable)

Ventilation system for SG area (i.e MCC/Switch gear rooms, electrical rooms, cable gallery and other rooms need supply air ventilation system inside ESP control room building) with unitary air filtration type air washer system will be provided. Saturation efficiency will be 70 % minimum.

Each UAF will consist 1x100% Centrifugal fan, 2x100% centrifugal circulating water pumps, air intake louvers, filters, evaporative cooling spray nozzles (Brass/ gun metal), UAF internals, ducting & piping network and other accessories. Cable galleries will be provided with miltilouvred gravity dampers to have positive pressure and also prevent dust nuisance. With this system the dry bulb temperature within the building will be maintained at a temperature not exceeding ambient temperature. The UAF capacity is to be decided based on:
Total internal heat load within the building, inclusive of electrical bay and maintenance bay and considering the heat dissipated by various electrical switchgear, equipment hot surfaces, steam piping as well as the dissipated heat, solar transmission through the building wall and glass, and any other sources of heat.

- Air change per hour (ACPH) as per design basis requirement
- Saturation Efficiency of air-washer will be 70% with spray system.

12.7.3 UAF for SG Area Building- Design and constructional details

i) UAF unit complete with air louver, single bank spray header with Polypropylene nozzles spraying water on flooded type water repellent filters, moisture eliminator, inspection window, marine light, maintenance cutaway etc. Saturation efficiency of UAF unit will not be less than 70%.

ii) Centrifugal pumps (one running & one stand by) complete with drive motors and accessories such as suction screen, pot strainer with bypass line valves, bends and fittings, inlet / outlet pressure gauge with isolating cock, complete make-up water plumbing with float valve, quick fill connection internal fitting

and supports, drain piping with valve, over flow connection, discharge piping etc will be provided.

iii) Piping for feed and make up water and also GI ducting grilles with volume control damper for UAF units will also be included.

iv) The sheet thickness for air washer tank will be 6mm and for the body of the air washer will be 5 mm.The casing and tank will be made of mild steel plate IS-2062 with epoxy protective paints inside and outside for corrosion protection. The distributor will be made of galvanised sheet steel and eliminators will be made of PVC.

v) The face velocity of air washer chamber will not be more than 2.5 m/sec.

12.7.4 Water Flooded Filter

i). The filter media will be of cleanable metallic type with efficiency 90% down to particle size of 10 microns when flooded with water.

ii). The filter media will be firmly secured on frame of rust proof material.

12.7.5 Moisture Eliminator Sets

i). Moisture eliminator sets used for the unitary air filtration units will be vertical and minimum 3 break type of PVC.

ii). Face velocity of air for the eliminator sets will not exceed 2.5 m/sec, Saturation efficiency of UAF ventilation system will not be less than 70 % for SG Area.

12.7.6 Design and Construction Details of Air Conditioning Systems

The equipment will be normally as per general specification of the project. However, brief description of main equipment is given below:

12.7.7 Vapor compression based Chiller

i) The packaged chilled water unit will be completely factory assembled and designed for continuous duty. Each package chiller unit will essentially comprise of rotary twin screw compressor, shell & tube type water chiller, refrigerant circuit, water cooled condenser, electric drives, instruments and controls and other standard accessories assembled in steel cabinet. The compressor will be semi-hermetically mounted on anti-vibration pads & dynamically balanced. Each chiller will have multiple screw compressors with independent refrigerant circuit.

ii) The chiller will be supplied with full operating charge of refrigerant R-134a & lubricating oil. Chiller performance will be ARI certified as per ARI standard 550. Cooler (evaporator) will be dry expansion type.

iii) Condenser will be shell & tube type construction dual refrigerant circuit water-cooled type. Unit will be equipped with suitable integral finned type, solid drawn, seamless copper tubes. The tubes will have internal turbulator. Fins will be made of Aluminium. Condenser shell will be constructed and tested in

accordance with section VIII, division I of ASME pressure vessel code. The shell will be capable to withstand refrigerant pressure of 300 psig, where as the tube side will be capable to withstand a water pressure of 150 psig. Cast iron water heads will be incorporated for easy removal, mechanical tube cleaning and/or tube replacement. Condenser will be provided with multiple pass to give optimum water velocity through tubes combining efficient heat transfer and allowable pressure drop.

iv) Fouling factor to be considered while designing the condenser will be 0.00025h-ft^2 F/Btu and temperature difference between inlet and outlet water will be approx. 7.5°F.

v) A special tube arrangement and the partition plate allow cooling water to pass through the condensed refrigerant and thereby sub-cooling the liquid. This produces higher refrigeration capacity without increasing the power consumption. Condenser will be tested as per ARI standard 550/590.

vi) Condenser will be provided with the following accessories / safety devices:

- Purge valve
- Charging valve
- Relief valve/ Fusible plug
- Liquid level indicator
- Flanged hot gas inlet / liquid outlet connection.
- Hand shut off valve for water inlet and outlet connection
- Flow switch in condenser water line
- Pressure & temperature gauges for water inlet and outlet
- Vent valve
- Drain valve

vii) Copper tubes of minimum diameter 16mm will be rolled in to grooves on tube sheet for a water tight and air tight joint. Joints between the tube sheet and the shell will be water tight while those between the shell and boxes will be airtight. Adequate sealing gaskets will be provided to prevent leakage of refrigerant and the infiltration of moisture and air in to the system Fouling Factor (water-side) 0.0001h-ft2F/Btu will be considered for design of cooler.

viii) Cooler shell will be capable of withstanding a pressure of 150 psig on shell side while 225 psig. on the tube side. Refrigerant will pass through the tube while water through the baffled shell. Refrigerant head is designed for proper number of passes to ensure refrigerant pressure drop is within the limit and adequate velocity for proper oil carry-over long with vapours.

ix) The chillier assembly will be thermally insulated with Armaflex material of 50mm thick and finished with aluminium cladding.

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x) Minimum superheat of 3o C under design condition will be considered while selecting the chillers.

Following controls and safety devices / accessories will be incorporated in the chillers.

- Cooling and Anti freeze thermostat
- Flanged water inlet and outlet connection with flanges and shut off valves, including industrial type thermometer.
- Relief valve, purge valve, drain valve
- Pressure and temperature gauges at the water inlet and outlet.
- Refrigerant charging connection in the valve
- Flow meter and switches on the water line.
- View port

12.7.8 Split type Air-Conditioner

Split air conditioning unit will mainly comprise of two sections, viz. Indoor and Outdoor section. Indoor section comprises of cooling coil, fan, filter and supply air grills. Outdoor section comprises of air cooled condenser, blower, hermetically sealed compressor. Sealed refrigerant piping interconnects the indoor and outdoor sections. Outdoor unit will be installed in open space for easy heat dissipation from condenser. Indoor section will be high ceiling suspended or wall mounted type as per requirement. Remote control unit, thermostat and other standard accessories for successful installation of split type air conditioner will be included in the scope of Contractor. Any additional services required will be included in line with requirement. Split air conditioner unit will conform to IS:1391-1992 Part II.

12.7.9 Window Air-Conditioner

Window type air conditioner will comprise of hermetically sealed compressor, air cooled condenser, refrigerant piping, fan, instruments and controls, supply air grills with direction deflectors etc. enclosed in an insulated steel cabinet. Provision will be made in the front panel of the unit for controlling room ventilation and fresh air supply. Air filter installed will be of HDPE easily cleanable type. The front panel will be suiting to the interior décor of the room.

12.7.10 Air Handling Unit

i) The Air handling unit (AHU) will comprise of the following sections. The AHU will be provided with suitable control, instrumentation and accessories including switch fuse unit.

(a). Filter section

(b). Coil section

(c). Damper section

(d). Blower section

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(e). Heater section

ii) Air handling unit will be made of GI sheet and rigid angle iron frame. Removable panels with double skin and sand witched insulation will be provided to make internal parts easily accessible for service and inspection, polyurethane foam (puf) insulation will be provided to prevent heat transfer to colder sections.

iii) Filter section should comprise of two filter banks, one, for pre-filtration and other for fine filtration.

iv) Velocity of air will not exceed 2.5 m/sec for pre filter and 1.5 m/sec for fine filter. Fine filter elements will be of superior compressed fill with adequate wool quantity.

v) Recommended pressure drop across filters when they are completely loaded is 12 mm WC.

vi) Filter framework will have lifting handles and locking metal wedges. Filter frame will be fabricated from MS sheet of suitable thickness in welded construction. All leakage areas should be sealed with suitable sealing compound.

vii) Cleaning efficiency of pre and fine filter will be according to manufacturer standard practice. Filter panels will be cleanable and reusable type.

viii) Coil section will have cooling coil manufactured from solid drawn copper tube with mechanically bonded aluminium fins. Face velocity of coil will not exceed 2.5m /sec. and pressure drop across the coil will be as minimum as possible.

ix) Damper section will be face and bypass damper. Damper should be suitable for automatic operation actuated by modutrol motor and modulating thermostat. Damper should have proportioning louvers so arranged that when face damper closes, bypass damper opens. No external bypass of air is acceptable

x) Manual dampers at the outlet of all the AHUs of air conditioning system will be provided.

xi) Centrifugal fan will be limit load characteristics.

xii) Impeller and shaft assembly of fan will be statically and dynamically balanced.

xiii) Centrifugal fan will conform to IS: 4894. Fan and motor assembly will be mounted on a common vibration proof base frame and the assembly will be provided with vibration arrestors, at the commissioning stage the vibration amplitudes will be measured to ensure that the vibrations are within the permissible limit.

xiv) Critical speed of the fan will be minimum 125% of the operating speed.

xv) Fan outlet will be fitted with canvass connections to isolate the vibration and outlet damper for the control of capacity.

xvi) Fan for AHUs will be provided taking care of pressure drop in the prefilter, fine filter, ducting losses in coil and other losses if any.

xvii) For fresh air requirement to AHU of ESP cum VFD Control room and for other areas, fresh air arrangement comprising of sheet metal fresh air duct will be provided with goose neck connection at intakes so as to serve as rain protection cover and bird guard. Filter element to match duct size and louvered damper complete with operation linkage to suit manual operation is to be provided. Fresh air filter element will be similar to that specified for prefilter earlier in the specification.

xviii) Heater section will consist of bank of electrically operated strip heaters to provide monsoon reheating as required and also winter heating for total air quantity to maintain specified inside design conditions. Selection of strip heater should be such that face velocity across heater is maintained at 2 to 3 m/sec. Heater bank frame should be electrically insulated for human safety. Heater will be flame proof/spark proof/tubular construction. Heater will be interlocked with AHU fan.

12.7.11 Cooling Tower

Induced draft type FRP cooling towers (1W + 1S) will be provided for the cooling of condenser water for chilled water air conditioning system. The cooling tower will be provided with fan & motor. The motor of fan will be of weather proof construction.

Cooling tower will be designed, manufactured and performance tested as per CTI codes. The capacity of the cooling tower will be adequate to take care of the cooling water requirement for the chilled water air conditioning system. The cooling tower will be mounted on RCC pillars near the air conditioning plant room. Inside fills will be of PVC.

Cooling tower basin will have accessories and connections for makeup, quick fill, drain screens and over flow. Float valve and limit switch interlocked with solenoid valves will be provided in the makeup water. The water distribution system will be either open basin with gravity feed nozzles or pipe system with nozzles requiring not more than 0.42 kg/sq.cm. water pressure at rated capacity. The nozzles will be spaced to give even distribution of water. The system will be self-draining, non-clogging and designed for flexible operation and ready accessibility. Suitable measuring orifices will be provided. All main piping connections will be brought out and will end in flanges to facilitate connections.

All the fasteners will be of stainless steel. Rubber/Neoprene gaskets must be used on all bolted joints as a seal against water leakage.

Nozzles for cooling tower will be of brass/gunmetal/stainless steel/ suitable material conforming to applicable standards. The cooling tower will be complete with ladder for maintenance and service requirements.

12.7.12 Insulation

i. Acoustic insulation

Acoustic insulation will be provided in the supply air duct up to 3m from AHUs. For applying acoustic insulation inside duct hot bitumen/ cold adhesive will be provided at the clean inside surface of duct. Then 25mm thick mineral wool will be provided. To hold the insulation 30 SWG perforated aluminium sheet will be provided and riveted with duct. Perforation will be of 5mm and 8 to 10mm centre to centre distance.

12.7.13 Thermal insulation

Thermal insulation will be provided on a portion of supply air duct out side the conditioned premises, pan humidifier, chilled water piping, drain pipes connected with insulated equipment etc. Thermal insulation of tail end duct will be provided to avoid condensation of moisture on the outside surface of the duct. The return air duct outside conditioned premises will also be insulated.

For applying thermal insulation, the outside surface of the duct/ pipe should be cleaned first, then hot bitumen/ cold adhesive should be applied on the clean surface. Then 50mm thick insulation material (mineral wool mat) with wire netting on outside will be provided. Then polythene with 50mm overlap will be sealed with adhesive. The polythene will be covered with 26 SWG aluminium sheet. All joints will be locked with self locking screw at a pitch of min 100mm.

12.7.14 Instruments and Controls

Following will be provided as applicable.

a) HP / LP cut out switch
b) Cooling and Antifreeze Thermostat
c) Pressure gauge and temperature gauge (6" dial type) in condenser water line and chilled water line
d) Water flow switch with interlock
e) Chilled water supply and return line valves, by pass valve, pressure and temperature gauges at supply and return line, AHU end
f) Refrigerant and water line strainers
g) Condenser purge, charging & relief valve
h) Refrigerant compressor HP, LP, OP gauges
i) Non return valve at pump out let
j) Any other instruments required for the system

12.7.15 Make up Water Tank

Make up water tanks will be provided for cooling tower of air conditioning systems. Tanks will be MS & inner surface spray galvanised. Make up water line with float valve & backup ball valve, quick fill line with ball valve, drain line with ball valve, overflow & vent line, level gauge will be provided.

12.7.16 Centrifugal Fan

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These are used for ventilation system. The fans will be of limit load design. The fan will be of rugged steel construction and suitable for industrial duty condition. Fan housing will be of welded construction and provided with flanges at inlet and outlet sides for duct connections. The housing will be provided with lifting eye for ease of handling and bolted type access door.

The fan unit will be reasonably noise and vibration free in operation. The noise level for fan and motor assembly at 1 meter distance will be limited to 85 dB (A). The fan will be single inlet single width (SISW) type as per requirement. The fan will be both statically and dynamically balanced.

12.7.17 Dry Panel Filter

Dry panel type air filter will be of high efficiency cleanable type, constructed out of HDPE (6 ply) supported by layers of GI wire gauge. It will be corrugated to the depth of filter casing in order to increase the ratio of filtration area to frontal area. It will be covered by strong GI/MS frame and have space to ensure uniform distribution of air. Filtering panel will be of standard size which can be mounted on angle frame in multiple number as per capacity of the fan. Face velocity of air will not exceed 2 m/sec. The resistance of air filter will not exceed 10 mmWC when dirty. Efficiency of the filter will not be less than 90% down to 10 microns. The whole filter and frame assembly will be fixed in a sheet metal casing of not less than 3.15 mm thick M S sheet.

12.7.18 Axial Flow (Tube Axial) Fan

These fans will be of heavy duty type. Fan impeller blades will be of aerofoil section of cast aluminium alloy. The impeller will be directly mounted on the motor shaft and the assembly will be mounted inside rigid tubular casing. Cable termination provision will be made on tubular casing. The connecting flanges will be provided at both ends of tube. Tube casing will be of minimum 2.5 mm thick M S sheet. The noise level for fan and motor assembly at 1 meter distance will be limited to 85 dB (A).

Axial Flow (Propeller) Fan

These are used for general ventilation of premises emitting heat / fumes. These will be of heavy duty and wall mounted type. Fan impeller blade will be aerofoil section and mounted directly on the motor shaft. Air entry from motor side. Louver shutter will be provided at the out let side of the fan to prevent back draft. Consequent loss in capacity will be taken in to account while selecting the fan. The noise level for fan and motor assembly at 1 meter distance will be limited to 85 dB (A).

Adjustable louver grills (Supply air Grills)

1.25mm MS sheet / 1mm GI sheet will be used for the manufacture of grill. All grills will be true to shape and will be checked with a level gauge before being secured in position. No distortion or warping is permitted.

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Self Acting Damper (Gravity Damper)

Self acting dampers are provided to maintain pressurisation inside the premises. The damper will be of gravity type designed such as not to allow infiltration of air from out side. The damper will be multi blade type made of aluminium flaps of not less than 24G thickness and MS frame. These will be designed such that these will operate when the pressure inside the premises exceeds 2-3 mm WC. It can operate in fully open or partial open positions.

12.7.19 Centrifugal pump

The pumps will be designed, manufactured and tested as per IS: 1520-1980 (R.A. 1993), IS: 5120-1977 (R.A.1997) Amendment 2000, IS: 9137-1978 (R.A. 1993), IS6595-1993 (Part II) or as per other international standards acceptable to the Purchaser and will be suitable for the duty conditions and capacities as indicated in this specification.

The power rating of the pump motor will be larger of the following 110% of the power required at the duty point.

For parallel operation, motor rating should be sufficient enough for running of single pump also.

i. Shaft

The shaft will be of EN-8 or C-40 or equivalent and will be designed for critical speed. The ratio of critical speed to speed of shaft will be not less than 1.2 for solid shafts.

ii. Shaft sealing

Mechanical type Shaft seals will be provided to prevent leakage out of, or into, a pump over the range of specified operating conditions. The seals will be suitable for variations in inlet conditions that may prevail during start-up and shut down. They will be accessible for inspection and replacement without disturbing any part of the installation.

12.7.20 Bearing

Two bearing assemblies will be provided, one within the frame to carry radial load only and the other to carry both radial and axial thrust. Bearings will be of manufacturer standard design, antifriction type, oil / grease lubricated. Suitable thrust bearings will be provided in the pump to take total thrust of the pump including hydraulic thrust. Thrust bearings will be of oil lubricated type with suitable cooling arrangement. Motor thrust bearing will be designed without water cooling arrangement. Suitable tapped holes will be provided for refilling of oil in the bearing housing.

12.7.21 Duct Work

Ducting will be fabricated from GI sheet as per IS: 655 standards. The ducting will be properly reinforced and braced to prevent sagging, buckling or vibration.

However minimum thickness of GI sheet will be 1mm considering the industrial duty conditions.

Flanges of sheet metal duct will be of angle iron type riveted with GI sheet on duct perimeter. Flange joints should be made air tight with use of felt gaskets. Spacing of duct flanges will be about 3 meters.

Turning guide vanes are to be provided inside the duct wherever change of direction occurs, to minimise eddy formation. The interior of all ducts will be smooth for free flow of air. Bends / elbows wherever used in duct work will have radius not less than the depth of duct work in change of direction. Collar is to be provided to duct bottom to connect with throat of supply air diffuser.

Access eye / measuring hatch for measurement of air quantity will be provided in ducting at convenient location. Duct work will be complete with flanges, stiffeners, fasteners, hangers, nuts, bolts, washer & gaskets etc.

12.7.22 Supply Air Diffusers

Supply air diffusers will be square / rectangular / circular in shape. The throat of a diffuser will be connected with collar piece provided at the duct bottom for holding the diffuser as well as for supply of air. No part of diffuser will project into the main duct. Each diffuser will be provided with volume control damper. Each diffuser will comprise of fixed plate, damper blade, damper blade operating knob, spindle, connecting rod etc and will be removable core type dully powder coated. The diffuser bottom should flush / match with the false ceiling. False ceiling will not bear the load of any diffuser. The load of any diffuser will be borne by the duct and collar. Each diffuser will be powder coated with appropriate colour to match with the colour of the false ceiling. The diffusers will be true to shape and will be checked with level gauge before being secured in position. No distortion or warping is permitted.

12.7.23 Return Air Duct

The air supplied in the served premises will return above false ceiling through return air grills / the return air slit of 50mm / 75mm (as required) all around false ceiling along the walls of the served premises. From there it will pass into the AHU room through a return air duct. Insulated return air duct of suitable size will be provided for smooth flow of return air. The return air duct will be connected to the AHU so that the AHU room will not be conditioned and this will avoid the heat load of the AHU room. Return air opening will be provided above false ceiling in the partition wall between served premises and AHU room.

12.7.24 Strip Heater Box

Strip heater box will comprise of finned heater, mounting plate, heater box/ casing made of 20 SWG G.I. sheet, cable terminal, terminal box with handle, 40x40x3 MS angle flange/ frame. Strip heater box will be placed/ inserted in supply air duct. Safety thermostat will be mounted on strip heater package to prevent

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overheating. Strip heater box assembly will be a pre-fabricated unit with all its terminals and controls pre-wired.

12.7.25 Multi-louvre Damper

Multi-louvre damper will be provided at the out let of AHUs and below flexible connection in the supply air ducting. The damper blades/ louvres will be provided with external operating links for manual operation of the damper to control air flow. The damper will be made of GI sheet with MS frame. The fully close / open / partial closing position of the damper will be marked on the damper casing.

12.7.26 Thermometer and Pressure Gauge

Wet bulb and dry bulb thermometer will be provided and installed in the control room to measure the premises temperature.

Dial type (100 mm) mercury in steel thermometer will be provided for measuring the water temperature at inlet & outlet of condenser. The range of thermometer will be 0-100 °C.

Dial type (100 mm) pressure gauges will be provided at inlet as well at outlet of condenser water lines.

12.7.27 Return Air Grills

Return air grills will be square / rectangular / circular in shape. The throat of a diffuser will be connected with collar piece provided at the duct bottom for holding the grills. No part of grills will project into the return air duct. The bottom of grills should flush / match with the false ceiling. Each grills will be powder coated with appropriate colour to match with the colour of the false ceiling. The grills will be true to shape and will be checked with level gauge before being secured in position. No distortion or warping is permitted.

12.7.28 Condenser cooling water piping with accessories

Medium class GI piping is to be used as per IS: 1239 for interconnecting water piping network. Velocity of water in the pipe line will be limited to 1.5 m/sec. Butterfly valve will be provided in water pipeline for control and regulation purposes. Butterfly valve and non return valve will be provided in the delivery side of pumps.

Pot strainer will be provided in the water pipe line at inlet of condenser with by pass connection with isolation valves. Pipe fittings like bends, elbows, flanges, sockets, nipples etc. will be as per relevant IS/BS standards.

Drain piping network is to be included as required for condensate drain, with isolation valves at proper places. All piping will be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure for period of not less than 24 hours. System may be tested in sections and such section will be securely capped.

12.7.29 Performance Parameters

The contractor will ensure the performance of ventilation and air conditioning systems on the following accounts:

- Ensuring specified capacities of various equipment
- Ensuring specified inside design conditions.
- The equipment will be statically & dynamically balanced.
- No overheating of bearings.
- No leakage in the ducting / piping system and equipment.
- Designed air flow at various points of system.

Performance testing and setting right of the equipment for the system will be carried out by the contractor at site.

12.7.30 Technical Data To Be Submitted

Contractor will furnish the following technical data for air conditioning and ventilation equipment / system during detail engineering and will ensure that such data/details will be in line with the requirements indicated in the Contract documents

Vapor Compression Machine	
1. Refrigerant Compressor a) Manufacturer b) Model No. c) Refrigerant d) Capacity at operating conditions with specific capacity of each type e) Maximum speed/operating speed f) BHP at operating conditions g) BHP/TR at operating conditions h) BHP consumption 100% load 75% load	DDE
2. Condenser a) Manufacturer b) Shell diameter and length (mm) c) Tube material d) Fouling factor e) No. of tubes	DDE
3. Water Chiller a) Manufacturer	DDE

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Vapor Compression Machine	
b) Shell diameter and length (mm) c) Tube material d) Fouling factor e) No. of tubes	
4. Air handling unit / fan coil unit. a) Make & Model No. with specific capacity of each type b) Type of unit (Horizontal/vertical) c) Overall dimensions (mm)	DDE
5. Fan Section a) Air quantity (m3/hr) with specific capacity of each type b) Total/static pressure (mmWC) c) Fan speed (RPM) d) Fan dia (mm) & number e) Balancing (Static and dynamic) f) Fan motor (kW)	DDE
6. Cooling coil a) Coil fin materials b) Tube dia (mm) and thicknes	DDE
7. Filter section Pre filter a) Type & make b) Gross filter area (m^2) c) Velocity through filter (m/sec) d) Pressure drop through filter when dirty & when clean (mmWC) e) Efficiency	DDE
8. Split Air Conditioners / Window Air Conditioners a) Make & Model b) Quantity c) Capacity in TR (Nominal / Actual)	DDE

Vapor Compression Machine	
d) Air Flow m^3/h	
9. Centrifugal Fan a. Fan i. Make & Model No. ii. Quantity, no. iii. Type of blade iv. Capacity, m^3/h v. Static and Total pressure, mm WC vi. Speed, rpm vii. Shaft power, kW viii. Total / Static Efficiency, % ix. Motor rating, kW/ pole	DDE
b. Fan Drive Motor i. Type & make ii. Voltage, phase & frequency iii. Rated power iv. Speed	DDE
c. Axial Flow Fan i. Make & Model ii. Capacity in m^3/h. iii. Total / Static Pressure, mm WC iv. Material of construction and its thickness v. Speed in rpm.	DDE
10. Centrifugal Pump Set i. Make and model no. with specific capacity of each type ii. Type of pump iii. Capacity in m^3/hr. iv. Total head in m WC v. Material of Construction of vi. Shaft	DDE

Vapor Compression Machine	
vii. Impeller viii. Casing ix. Pump speed (rpm) x. Shaft power xi. Drive details xii. Motor make xiii. Motor kW xiv. Class of insulation xv. Frame size	
11. Dry Panel Filter f) Make & Model. g) Capacity in m^3/h. h) Pressure drop in mmWC. i) When clean ii) When dirty i) Effective cross sectional area in m^2	DDE
12. Cooling tower a) Make & Model b) Type c) Quantity d) Overall size of cooling tower e) Capacity of cooling in TR. f) Water flow m^3/h	DDE

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SECTION: C 2B

CUSTOMER SPECIFICATIONS

GENERAL TECHNICAL REQUIREMENT
GENERAL TERMS & CONDITIONS OF CONTRACT,
SAFETY CODE FOR CONTRACTORS,
GENERAL CONDITIONS FOR ERECTION WORKS AND CIVIL WORKS
&
PERFORMANCE GUARANTEES

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2.1 Codes and Standards

1. Except where otherwise specified, the SG and its auxiliaries will comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Contractor will give all particulars and details as necessary.
2. Where the Contractor proposes alternative codes or standards he will include in his tender one copy (in English) of each Standard Specification to which materials offered will comply. In such case, the adopted alternative standard will be equivalent or superior to the standards mentioned in the specification.
3. Wherever specified or required the SG and its auxiliaries will conform to various statutory regulations including but not limited to Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the SG and its auxiliaries supplied under the specification from statutory authorities will be the responsibility of the Contractor.
4. 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 will govern.
5. In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner/Consultant will have the option to incorporate the changed requirements. It will be the responsibility of the Contractor to advise Owner/Consultant of the resulting effect. Financial implications if any will be discussed mutually agreed and finalised.

2.2 Responsibility for Design

1. The Contractor will take full responsibility for the design of the whole and every portion of the SG , 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. 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 will have been adequately developed and will have demonstrated their performance adequately under similar site conditions.
3. The Contractor will have to carry out transient condition studies as may be necessary and as required by the Owner/Consultant as per good industry practice.
4. The Contractor may choose to include a detailed discussion on the development status and the reasons for any changes made in proposed systems or components for the SG, as compared with similar items previously supplied in other installations cited by the Contractor as reference plants. In that event the Contractor will substantiate such changes without changing the functional capability of the SG.

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2.3 Name Plates (Rating Plates)

1. Instruction plates, nameplates or labels will be permanently attached to each main and auxiliary item of SG in a conspicuous position. These plates will be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of SG has been designed to operate.
2. All equipment tag numbers with equipment name will be painted on large equipments or else SS tag plates bearing tag numbers will be hung on all small equipments like valve, strainers tec. Items such as valves, etc. which are subject to hand operation, will be provided with name plates so constructed as to remain clearly legible throughout the life of the SG giving due consideration to the difficult climatic conditions to be encountered. Nameplates will be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment.
3. All trade name plates and labels will be in English language. All measurements will be in M.K.S/SI Units.

2.4 Safety and Security

1. The design will 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 will comply with all appropriate statutory regulations relating to safety.
2. Ready and safe access will be provided to all equipment of the SG and auxiliaries for inspection, cleaning and maintenance.
3. The use of explosive, toxic or otherwise hazardous materials etc will be kept to a minimum during construction and the design of the SG & minimise requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions will be taken in the design, manufacture and layout of equipment to minimise the potential hazard, and all equipment, gadgets and accessories necessary for the protection will be provided. Usage of asbestos or any other banned material in any form is not permitted.

2.5 Guards

1. Effective guards and fences must be provided for the equipment as may be necessary for safe operation & maintenance to prevent accidents.
2. Steel mesh guards of suitable gauge which allow visual inspection of equipment with the guard in place are generally preferable. The guards will be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and galvanised. The guards will be so designed to facilitate easy removal and replacement during maintenance.
3. All drive belts, couplings, gears 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.
4. Guards for couplings and rotating shafts of approved standard.

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2.6 Location and Layout Requirements

1. The majority equipment of SG island (except otherwise specified) will all be of outdoor installation. Layout should facilitate access for operation, maintenance and inspection of any equipment/components without disturbing the operation of rest of the plant.
2. The Contractor will try to retain the layout as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Contractor may, subject to Owner's/Consultant approval after the same to suit the space requirement of the equipment offered.
3. Contractor may suggest as an alternative his own preferred layout clearly indicating the relative merits, if any. Such alternative will be submitted to Owner/Consultant in terms of techno commercial consideration.

2.7 Operation, Maintenance & Availability Considerations

1. Equipment/works offered will be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Contractor will specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He will also furnish details of performance parameters of SG and auxiliaries stated in his reference list.
2. Sufficient space for ease of operation and maintenance will be provided. All valves, gates, dampers and other devices will be located and oriented in such a way that they are accessible from operating floor levels.
3. The design and engineering, while choosing equipment will include, where possible, to ensure interchange ability of parts or components so as to minimise inventory.

2.8 Materials

1. In selecting materials of construction of equipment, the Contractor will pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. All materials will be new, and will be of the quality most suited to the proposed application.
2. As far as possible, materials will be in accordance with national or international standard specifications and will be used in accordance with national or international codes of practice. Where such standards or codes of practice are not available sufficient information will be provided to allow the Owner/Consultant to assess the suitability of the material for the particular application.
3. 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 will be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the SG and auxiliaries.

2.9 Lubrication

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

2. Non ferrous capillary tubing will be used throughout.
3. Gear boxes and oil baths will be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication will be provided.
4. All high speed gears will be oil bath lubricated. Low speed gears will be lubricated by means of soft grease. Removable and accessible drip pans will be provided to collect lubricant which may drop from operating parts.
5. All lubrication points will 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 will be fitted.
6. The Contractor will supply grease gun equipment suitable to service each type of nipple fitted.

2.10 Lubricants and Control Fluids

1. The Contractor will provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the SG and auxiliaries. A sufficient supply of these will be provided by the Contractor for initial commissioning, first fill and upto successful completion of trial operation.
2. The Contractor will 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 will be provided. The Contractor will endeavour 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 will be of internationally recognised standards and will be easily obtainable from a large number of suppliers. Contractor will also indicate the equivalent Indian Standard for the above for easy procurement in future.
3. No lubricant or control fluid will have toxic or other harmful effects on personnel or on the environment.

2.11 Operation and Maintenance

1. The SG and auxiliaries will be designed and constructed so that operation and maintenance manpower requirements are minimised.
2. Spare parts for equipment will be interchangeable with the original components.
3. All similar standard components/parts of similar standard equipment provided will be interchangeable with one another. Further identical equipments will be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
4. On completion of commissioning, a complete set of tools for the maintenance of the entire SG and auxiliaries will be provided by the

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Contractor. Tools used during erection and commissioning will not be accepted except with the specific approval of the Owner/Consultant.

2.12 Life and Mode of Operation

The steam generator and auxiliary equipment apart from being capable of operation on base load will also be suitable for cyclic load variation. However, continuous operation of the Plant under cyclic modes may also be required for it to participate in automatic load frequency control system. In design consideration and criteria for cyclic operation of the Unit it will be ensured that under such operating condition, no portion of the steam generator and auxiliaries will be stressed beyond acceptable safe thermal stress and fatigue levels based on cyclic loading, number of cold, warm & hot starts, likely variations in steam parameters etc. For ensuring these requirements the Unit will be equipped with adequate temperature measurements, the signal for which will be suitably processed to give guidance to the Operator to regulate loading within permissible rates from time to time.

The SG and auxiliaries will be designed for the range of operational flexibility associated with the above duty conditions.

2.13 Packaging & Marking

The identification marking indicating the name and address of the consignee will be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor will include in the marking gross and net weight, outer dimension and cubic measurement. Each package will 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.

2.14 Protection

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

Electrical equipment controls and insulations will be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items will 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 will be greased and protected with metallic or other substantial type protectors.

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

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

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2.15 Environment Protection and Noise Level Requirement

2.15.1 Environment Protection

The SG and auxiliaries will be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control will be ensured by the Contractor to restrict air and water pollution within the stipulated limits as mentioned below and in accordance with Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate additional conditions not specified hereunder while clearing the project will be complied with the SG by the Contractor.

For Water Quality

a) Conform to MINAS (Minimum National Standards) & IS: 2490.

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

For Air Quality

a) Suspended Particulate Matter - 50 mg/Nm^3 at chimney outlet.

b) NOx - less than 260 gm/GJ of heat input at reference O_2 level of 6% at APH outlet

In absence of Standard emissions in India, for certain gaseous emissions in India, internationally accepted World Bank Standard is to be followed. The Contractor will include in his scope all equipment and measuring instruments to comply with above standards. Location and accessibility of the instruments will be properly co-ordinated.

2.15.2 Noise

The plant will be designed, and supplemented with suitable acoustic measures to ensure desired/ stipulated noise level criteria as per the recommendation of OSHA standards or as per the following stipulations, whichever is stringent.

a) Maximum noise level will not exceed 85 dB (A) for all running equipments and 92 dB (A) for beater wheel mills when measured in1.0M away from the noise emission source in accordance with ISO 3746. OR meet the requirement of Pollution Control Board norms, whichever is stringent)

b) Any statutory changes in stipulations regarding noise level that may be warranted in future by State Pollution Control Board or Central Pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Contractor will comply with the same.

Excluded from the noise requirements are the boiler transient conditions such as SG start-up, shut down, HP bypass operation, pressure relief valve and safety valve operation.

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2.15.3 "Intentionally deleted."

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SCHEDULE – 10

GENERAL TERMS AND CONDITIONS OF THE CONTRACT

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SCHEDULE-10

GENERAL TERMS & CONDITIONS OF CONTRACT

10.1 Bank Guarantees

10.1.1 General

1. All the Bank Guarantees shall be irrevocable and shall be from any nationalised / scheduled Bank in India authorized by Reserve Bank of India, other than Bank of China, acceptable to the Purchaser and drawn in favour of NLC Limited Neyveli.

   All the Bank Guarantees are to be furnished by the Bank directly to the Purchaser through RPAD/Speed Post/Courier.

2. The Bank Guarantee shall be as per respective format prescribed and shall be submitted on Non-judicial stamp paper of appropriate value and the stamp paper shall be in the name of the Bank.

3. All the Bank Guarantees shall be payable on first demand, without demur, irrespective of any legal dispute between the Bank and the Contractor to the Purchaser without any condition or dispute whatsoever.

4. The Contractor shall arrange to keep alive the several bank guarantees referred to herein for the requisite duration by making timely request to the Bank or Banks concerned. All the extension / amendments for Bank Guarantees also shall be on non-judicial stamp paper of appropriate value obtained in the name of Bank.

5. No interest or any bank charges shall be payable by the Purchaser in respect of any Bank Guarantee furnished by the contractor in respect of this contract with respect to the period upto completion of all obligations under the Contract by the Contractor.

6. The Purchaser shall have the right to en-cash the Bank Guarantees for non-compliance of any or all the terms and conditions of the contract. Non - compliance of any or all the terms and conditions of the contract by the Contractor, will be intimated to the Contractor, specifying the reason with supporting documents, before encashment of the Bank Guarantee.

10.1.2 Bank Guarantee for Advance Payment (APG)

The advances stipulated in the payment terms shall be made to the Contractor by the Purchaser subject to the Contractor providing a bank guarantee for 110% of the advance amount as per the stipulations and Purchaser's acceptance of the said bank guarantee. The bank guarantee shall be valid till the completion of respective scope of work with a grace period of 2 (two) months thereafter. The bank guarantee value shall be reduced on the basis of actual recovery of advances from the bills of respective scope of work on quarterly basis. Proforma for Bank Guarantee for Advance Payment is in Annexure-XV.

10.1.3 Contract Performance Guarantee (CPG)

1. The Contractor shall submit an irrevocable Contract Performance Bank Guarantee within 30 days from the date of Letter of Award.

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2. The Contractor shall furnish to the Purchaser, Bank Guarantee in the prescribed pro-forma towards Contract Performance for a value of ten (10) per cent of the Contract price plus price variation if any, in favour of the Purchaser. The Bank Guarantee shall be for the time bound, due and faithful performance of the contract and shall remain binding notwithstanding such variations, alterations or extensions of time as may be made, given, conceded or agreed to between the Contractor and the Purchaser under these General Terms & Conditions or otherwise. The Bank Guarantee shall be from a Nationalised / Scheduled Bank in India. The Bank Guarantee towards Contract Performance shall be subject to approval of the Purchaser thereafter. The Contractor shall ensure that the Contract Performance Bank Guarantee remain valid till the expiry of the guarantee period of the Contract plus three months grace period. The Contract Performance Bank Guarantee submitted by the Contractor as above and accepted by the Purchaser is enclosed at Annexure-XIV in Contracts - I, II & III.

3. The Contract Performance Bank Guarantee furnished by the Contractor will be subject to the terms and conditions of the Contract. The Purchaser will not be liable for payment of any interest on the Contract Performance Guarantee or depreciation thereof.

4. The Contract Performance Bank Guarantee shall be released on application by the Contractor within ninety (90) days after the expiry of the warranty period and after the Contractor has discharged all his obligations under the Contract including release of Custom Bond and produced a "No Demand Certificate" from the Purchaser. The Purchaser shall not unreasonably withhold the issue of "No Demand Certificate" after receipt of request for the same.

5. The performance guarantee shall cover additionally the following guarantees to the purchaser:

   (i). The Contractor guarantees the successful and satisfactory operation of the equipment furnished under the contract as per the specification and documents.

   (ii). The contractor further guarantees that the equipment provided and installed shall be new and free from all defects in design, material and workmanship. The Contractor shall upon written notice from the purchaser, fully remedy free of expenses to the purchaser such defects as may develop under normal use of the said equipment within the period specified in the contract.

   (iii). The Contractor also guarantees the proper performance of the steel structures, for a period of twelve (12) months from the date of final takeover of the plant and equipment. Any defect found during this period will be made good by the contractor at his own cost failing which the purchaser reserves the right to take remedial measures at the contractors' risk and cost.

6. The Purchaser shall have the fullest liberty to lodge their claim for encashment of the guaranteed sum either in full or part, in the manner suitable to them, by intimating the Contractor specifying the reasons with supporting documents, before encashment of the Bank Guarantee. However, payment made for a

sum lesser than the guaranteed amount shall not relieve or discharge the bank from their obligations guaranteed under the bank guarantee, till the contractual obligations or fully performed by the Contractor or the Bank Guarantee is discharged by the Purchaser, as the case may be under the Bank Guarantee shall continue to be in force till such time.

7. Deleted.

10.1.4 Retention Money Bank Guarantee (RMBG)

If the Performance Guarantee (PG) tests and the Final Takeover is delayed beyond six months from the schedule due to reason not attributable to Contractor, final 10% / 5% for supply /erection/civil works as stated in the terms of payment shall be released against production and acceptance of bank guarantee (as per the Retention Money Bank Guarantee format enclosed as per Annexure-XIX of this Volume-I) for an equal amount valid for one year or the revised schedule date of performance guarantee tests and Final takeover whichever is earlier. If the PG tests and Final Takeover gets delayed further due to reasons not attributable to the Contractor then further extension of validity of the Bank Guarantee, beyond one year, shall be mutually discussed and agreed.

10.1.5 Financial Back-up Bank Guarantee

The financial back up guarantee, by the Associate M/s. Alstom Boiler Deutschland GmbH, Germany furnished to the Purchaser for a value of 5% of their respective portion of the work, valid till the expiry of the guarantee period of the Contract plus three months grace period is enclosed at Annexure-XXIII in Contracts - I, II & III. The Purchaser shall have the right to encash the financial backup bank guarantee for non-compliance of any or all the terms and conditions of the Letter of Consent as per Annexure-XXI, as well as for shortfall in guaranteed values applicable for Steam Generator as enumerated in the contract.

10.1.6 Liquidated Damages Bank Guarantee (LDBG)

Liquidated Damages levied towards non-fulfillment of time schedule as per Schedule-4 of this Volume-I may be considered for release as under:

90% of the withheld/ leviable Liquidated Damages amount may be considered for release against submission of Liquidated Damages BG for 100% amount withheld/ leviable and acceptance by the Purchaser (as per Annexure-XXIV of this Volume-I).

10.2 Licences

10.2.1 Import Licence

Intentionally deleted.

10.2.2 Export Licence

Intentionally deleted.

10.3 Insurance

The Contractor shall take insurance policies as mentioned below and the same shall be submitted to the Purchaser for approval failing which the progressive payment of 65% as per Schedule – 6 of Supplies Contract, will not be effected.

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10.3.1 Marine cum Erection (MCE) Insurance

1. The Contractor shall take Marine-cum-Erection insurance policy against all risks to the equipment /materials during handling, transit (marine and inland), storage, erection, testing and commissioning for the total contract price including price variation. The period of policy shall commence from the despatch of first consignment of equipment/materials for the work and continue during transit, storage, erection at site till completion of testing commissioning and upto Provisional Takeover of the second unit as per Contract. After Provisional Takeover of the first unit, the sum insured value can be reduced to that extent.

   Alternatively, the Contractor may take a Transit / Marine Insurance policy and a Storage-cum-Erection Insurance policy against all risks to cover the loss or damage during Transit and Storage & Erection respectively. The sum insured under the policy shall represent the cost of equipment / materials supplied by the Contractor for the work. The sum insured under the Storage-cum-Erection policy shall represent the complete erected value of Plant & Equipment including freight, insurance, taxes and duties and erection cost.

   If the Contractor is already having an open Transit /Marine Insurance policy, the copy of the same shall be furnished.

2. The Contractor shall also take additional covers (Add-On covers) given under MCE insurance like Third Party Liability, Surrounding properties, Clearance and Removal of debris, Cross liability, Additional Customs Duty, Express Freight, Extended Maintenance Cover upto Final Takeover, etc. The sum insured for such Add-On covers shall be decided by the Contractor based on its assessment and risk involved in the contract.

3. Risks to be covered by insurance shall not be limited merely to the items mentioned above. The Contractor shall arrange for insurance of any other risks he may deem prudent, but the expenses thereof shall be to the account of the contractor only.

4. If necessary, Transit and storage (all risks) insurance coverage for additional transit involved for sending equipment/material to Sub-Contractor/ Fabricator's shop for fabrication/ reprocessing and receiving back at site shall be taken.

5. The form and the limit of such insurance as defined shall be acceptable to the Purchaser. However, irrespective of such acceptance, the responsibility to maintain insurance at all times during the required period and for the required value shall be that of the Contractor alone. The Contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations.

6. The transfer of title shall not in any way relieve the Contractor of the above responsibilities during the period of the contract. Any loss or damage to the equipment during handling, transporting, storage and erection, till such time the plant is provisionally taken over (Provisional Takeover) by the Purchaser, shall be to the account of the Contractor. After all the instalments of premium are paid, on Provisional Takeover of the plant, the difference between the lumpsum charges indicated in Schedule-3 Contract Price and the premium actually paid to the Contractor shall be paid to the Contractor on

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the basis of invoices from the Contractor without supporting documents, The Contractor shall be responsible for preferring of all claims as applicable and make good at the Contractor's own cost for the damage or loss by way of repairs and/or replacement of the portion of the works damaged or lost for the timely commissioning of the equipment/ completion of the works. Licenses, clearance etc., if any required for the purpose of replacement of equipment lost/damaged in transit and/or during storage, erection, shall be made available by the Contractor.

7. The contractor shall provide the purchaser with priced copy of all insurance policies and documents taken out by him in pursuance of the contract. All copies of such documents shall be submitted to the purchaser immediately after such insurance coverage for approval.
8. The Contractor shall also inform the Purchaser in writing at least 60 days in advance regarding the expiry cancellation and/or change in any of such documents and ensure revalidation/renewal etc, as may be necessary well in time.
9. The Insurance policy shall provide for payment of claim both in foreign currency and Indian Rupees.
10. The Purchaser shall be the principal holder of the policy along with the Contractor the Purchaser reserves the exclusive right to assign the Policy.
11. All costs on account of Insurance charges/premium on lumpsum and firm price basis shall be indicated in the price schedule. The premium receipt issued by the Insurance Company shall have to be produced for claiming the payment. However, the total premium to be reimbursed shall be restricted to the lumpsum agreed to in the price schedule in the contract. However, the Contractor's responsibility to maintain the insurance cover as per the terms of contract at his cost will not cease after reaching the lumpsum quoted. After all the instalments of premium are paid, the difference between the lumpsum charges indicated in the price schedule and the premium actually paid to the Contractor will be paid to the Contractor on the basis of invoices from the Contractor without supporting documents on Provisional Takeover.

10.3.2 Workmen's Compensation Insurance

The Contractor shall take Workmen's Compensation Insurance for this project work. This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India) as amended from time to time. This policy shall also cover the Contractor against all claims for injury, disability, disease or death of his or his Sub Contractor's employees which for any reason are not covered under the Workman's Compensation Act, 1948. The liabilities shall not be less than:

- Workmen's compensation: As per statutory provisions.
- Towards Employees Liability: As per statutory provisions.

The Contractor shall provide the Purchaser with a copy of Workmen Compensation insurance policies taken out by him in pursuance of the Contract.

10.3.3 The Contractor taking Insurance policies for the total contract price indicated in the contract but only for part period or part liabilities which shall result in non

fulfillment of contractual conditions for the whole period of the contract or failure to cover all liabilities shall attract penalty recovery from the Contractor as deemed fit as decided by the Purchaser.

10.4 Customs Clearance

Intentionally deleted.

10.5 Liquidation, Death, Bankruptcy etc.

10.5.1 If the Contractor shall die, dissolve or become bankrupt or insolvent or cause or suffer any receiver to be appointed on its business or any assets thereof with its Creditors, or being a corporation commence to be wound up, not being a member's voluntary winding up for the purpose of amalgamation or reconstruction, or carry on its business under a Receiver for the benefits of its Creditors or any of them, the Purchaser shall be at liberty:

(a). to terminate the Contract forthwith upon coming to know of the happening of any such event as aforesaid by notice in writing to the Contractor or to the Receiver or Liquidator or to any person in whom the Contract may become vested to, or

(b). to give such Receiver, Liquidator or other person the option of carrying out the Contract subject to his providing a guarantee upto an amount to be agreed for the due and faithful performance of the Contract.

10.6 Responsibility for Performance of Contract

1. The Contractor shall be responsible for the due and faithful performance of the Contract in all respects according to the drawings, specifications and all other documents referred to in this Contract. Any approval which the Purchaser/Consultant may have given in respect of the drawings/documents, specifications, stores, materials, supplies or other particulars and the work or the workmanship involved in the Contract (whether with or without test carried out by the Contractor or the Purchaser) shall not relieve the Contractor from its obligations and notwithstanding any approval or acceptance given by the Purchaser/ Consultant, it shall be lawful for the Purchaser to reject the material on arrival at site, if it is found that the materials supplied and/or erection and/or construction work carried out by the Contractor are not in conformity with the terms and conditions of the Contract in all respects.

2. The Contractor shall co-operate with the Purchaser's other contractors, if any, for any associated plant and freely exchange all relevant technical information with them to obtain the most efficient and economical design and to avoid unnecessary duplication of equipment. The Contractor shall also coordinate with other contractors for any interface activity at his battery limits. No remuneration shall be claimed from the Purchaser for such technical cooperation.

10.7 Responsibility for Completeness

1. Any supplies and services which might not have been specifically mentioned in the Contract but are necessary for the design & engineering, supply, erection, commissioning, performance and/ or completeness of the works, shall be supplied/provided by the Contractor without any extra cost

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to the Purchaser within the time schedule for efficient and smooth operation and maintenance of the works under Indian conditions, unless expressly excluded from the scope of supplies and services in this Contract.

2. The approval by the Purchaser/Consultant at any stage for any supplies and services by the Contractor shall not relieve the Contractor of its obligations.

10.8 Despatch and Billing Schedule

1. The Contractor shall prepare a detailed Billing-cum-Despatch Schedule in the logical sequence required for services within the overall delivery schedule of the Contract. Billing-cum-Despatch schedule for the Plant and Equipment shall be submitted within 60 days from the date of Letter of Award of the Contract. Detailed shipping schedule shall be submitted within 6 months from the Letter of Award of Contract indicating the breakdown of the complete Plant into shipment units with approximate weights and dimensions and the respective dates upon which such units will be despatched from the Contractor's and/or his Sub-Contractor(s) works.
2. The Billing-cum-Despatch Schedule and the Shipping Schedule is subject to approval of the Purchaser/Consultant. Six (6) copies of the approved Billing-cum-Despatch Schedule and Shipping Schedule shall be submitted to the Purchaser within 15 days from the date of approval.
3. No early payment shall be made for non-sequential or early delivery of any Plant & Equipment which will be required for erection at a later date. Further, the early delivery of such equipment will occupy storage space, which will be the responsibility of Contractor.
4. The lapse of guarantee due to delay in performance guarantee test of any such equipment, if it is supplied by any associate/sub-vendors, is the responsibility of the Contractor.

10.9 Shipping Notes and Documents

10.9.1 Shipment Notification: Intentionally deleted

10.9.2 Transport

1. Ocean transportation and shipping procedure for imported equipment:
   (a). The Contractor shall furnish to the Purchaser at least 3 months before the commencement of the supplies a programme of despatches as scheduled by the Contractor to enable the Purchaser to have an effective follow up. Part shipment is permitted.
   (b). The Contractor shall furnish a list of items with value of goods imported through Chennai Port and furnish concerned detailed information at least 3 (three) months prior to the actual date of commencement of supplies.
   (c). The terms of the Contract, being on FOB basis the goods at the time of shipment will be the Cargo of Government of India. The Contractor shall make shipping arrangements through the Ministry of Surface Transport, Transport Bhawan, 1, Parliament Street, New Delhi – 110 001 through

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their respective forwarding agents/nominees as mentioned below. Adequate notice of not less than 6 (six) weeks, on the readiness of cargo for shipment, should be given by the Contractor from time to time for finalising the shipping arrangements. While giving such notice of readiness, the Contractor shall furnish the following in triplicate to the forwarding agent and Ministry of Surface Transport under intimation to the Purchaser:

(i). Contract No.

(ii). Brief description of material to be shipped.

(iii). Gross weight.

(iv). Net weight.

(v). Dimensions of the packages to be shipped.

(vi). Number of packages.

(vii). Import Licence No., if any and L/C particulars.

(d). The freight forwarder shall thereafter communicate to the Contractor, the name of vessel and estimated time of sailing to enable the Contractor to transport the items to the port of shipment and deliver them at port. The Contractor shall also handover the necessary shipping documents to the freight forwarder simultaneously.

S.No	Area	Forwarding Agent / Nominee
1	UK- including Northern Ireland, Eire, the North Continent of Europe (West Germany, Holland, Belgium, France Norway, Sweden, Finland and Denmark) and ports on the Continental Sea-board of the Mediterranean (i.e. France and Western Italian ports) and also Adriatic ports.	M/s Panalpina World Transport, Panalpinawelt Transport GmbH, Spaldingstr-64, D20097, Hamburg Tel No:. +49 4023771-133, Fax No: +49 4023771-342 OR 344
2	USA & Canada	M/s OPT, Overseas Project Transport Inc. 46, Sellers Street Kearny, N.J. 07032, U.S.A. Tel: (201)998-7771 Fax: (201)998-7833 Telex: 673-3586 Opt
3	Japan	The first Secretary(Commercial) Embassy of India, Tokyo, Japan Cable: INDEMBASSY: TOKYO
4	South Korea	The first Secretary (Commercial) Embassy of India, San-2-1,Bokwang-Dong, Yongsen-Ku, (Behind Bowling Centre) Seoul, South Korea

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S.No	Area	Forwarding Agent / Nominee
5	Russia	The Secretaries, Indo-Soviet Shipping Service, C/o The Shipping Corporation of India Ltd., "Shipping House" 245 Madame Cama Road, Bombay- 400021 Cable: SHIPINDIA: BOMBAY FOR SOVINDSHIP Fax:(022)202 2949/6905 Tele:(022)202 6666
6	Poland	The Secretaries, Indo-Polish Shipping Service, C/o. The Shipping Corporation of India Ltd. "Shipping House", 245 Madame Came Road, Bombay 400021, Cable: SHIPINDIA: BOMBAY FOR SOVINDSHIP) FAX: (022)
7	Other Areas	The Shipping Coordination Officer, Ministry of Surface Transport (Chartering Wing) New Delhi Cable: TRANSCHART, New Delhi Fax: 011-3718614/3352726

(e). The Contractor shall approach the above shipping agencies. If the terms & conditions of shipping agencies are not feasible to the Contractor, the same shall be informed to the Purchaser and with the approval of Purchaser, Contractor may arrange other shipping agencies. The Purchaser will give such approval with out delay.

2. If situation warrants, the Contractor may arrange air freight with prior approval of the Purchaser. In such case the increase in freight and customs duties thereof shall be to the account of Contractor.

3. All shipments will be done through approved vessels as per the `Institute of London Classification Clause' of the Institute of London /Underwriters' Institute Classification Clause as given below.

4. The Marine Transit rates agreed for this insurance apply only to cargoes and/or interests carried by mechanical self-propelled vessels of steel construction, classed as below by one of the following classification societies.

- Lloyds Register - 100A1 or BS*
- American Bureau of shipping - *A1 R
- Bureau Veritas - 13/3E* V
- Germanischer Lloyd - *100A^4 G
- Korean Register of shipping - *KR S1 J
- Nippon Kaiji Kyokai - NS* N

• Norske Veritas	-	1A1	N
• Registro Italiano	-	*100A 1.1 Nau	L
• Register of shipping of the USSR	-	KM*	S
• Polish Register of shipping	-	*KM	P

Provided such vessels are:

(i). Over 15 years of age but not over 25 years of age and have established and maintained a regular pattern of trading on an advertised schedule to load and unload at specified ports.

(ii). Chartered vessels and also vessels under 1000 GRT which are mechanically self propelled and of steel construction must be classed as above and not over 15 years of age. And for the Chartered vessels of 15 years of age the Contractor shall produce a certificate as follows:

"The shipment by sea-worthy vessels classed 100 A1 Lloyds or equivalent classification society and approved by General Insurance Company of India".

If the suppliers do not adhere to the above condition and if the insures charge extra premium due to overage or non-classification of vessels, the suppliers may have to be held liable to pay the extra premium incurred.

5. The bills of lading should be drawn so as to show:

SHIPPER	:	THE GOVERNMENT OF INDIA
CONSIGNEE	:	PROJECT MANAGER - NNTPP 2x500 MW,NEYVELI NEW THERMAL POWER PROJECT NEYVELI, CUDDALORE DISTRICT, TAMIL NADU, INDIA
PORT CONSIGNEE	:	ADDRESS OF CONTRACTOR / CLEARING AGENT OF CONTRACTOR
IMPORTER	:	PROJECT MANAGER -NNTPP 2x500MW, NEYVELI NEW THERMAL POWER PROJECT NEYVELI, CUDDALORE DISTRICT, TAMIL NADU, INDIA

6. The Contractor shall forward the non-negotiable copy of the bill of lading indicating the gross freight amount and rebate allowed to the Shipping Co-ordination Officer, Ministry of Transport, Department of Surface Transport, New Delhi immediately once the shipment of each consignment is effected.

10.9.3 Shipping Documents for Imported material

1. The Contractor shall send the following negotiable shipping documents to the Purchaser:

(a). Three (3) original and 6 (six) copies of clean bill of lading or one (1) clean Airway Bill & 3 (three) copies, in case of air freight.

(b). One (1) original & five (5) copies of Contractor's signed invoices.

(c). Six (6) copies of packing list.

(d). Six (6) copies of certificate of' country of origin

(e). Six (6) copies of Purchaser's dispatch clearance.

Dispatch clearance shall be provided automatically on inspection at works against last hold point in Quality Plan. For the cases where the scrutiny and review by the Consultant is required, the same will be indicated in the QAP after mutual discussion and agreement

(f). Six (6) copies of inspection certificate, if any, issued by the Purchaser/his authorised representative.

(g). Six (6) copies of certificate from the Contractor to the effect that drawings and catalogues for customs clearance purpose have been kept with the packages for shipment.

(h). Six (6) copies of certificate from the Contractor to the effect that the contents in each case are not less than that entered in the invoices and guaranteed as new and as per the relevant technical specifications.

The Contractor shall distribute to the Purchaser the following documents:

- Bill of lading (two copies)
- Shipping Specification (one copy)
- Quality Certificate (one copy)

(i). Approved Test Certificates if any with the cargo

- Quality certificate (one copy)
- Packing list (6) copies comprising 2 copies in case No.1 of each consignment of the goods and 4 copies in each case (three inside the Box and one copy in a special packet at the outer side of the Box).

2. The negotiable shipping documents shall be handed over to the Indian Contractor by the Purchaser. The Contractor shall prepare the bill of entry based on the original documents and get it assessed by Custom Authority.

3. After port clearance and custom clearance the Contractor's responsibility shall be taking the delivery of materials from port, subsequent handling, transportation and storage at site against submission of the Custody-cum-Indemnity Bond for full value of supplies in the Purchaser's approved proforma.

4. The demurrage/port charges, if any, on account of the delay in unloading the materials/port clearance / delayed receipt of negotiable document by Purchaser shall be borne and paid by the Contractor. Port of Destination shall be Chennai Port, TamilNadu, India.

10.9.4 Shipping documents for Indigenous Materials

1. **General**

The consignee for both rail and road despatches shall be clearly marked as NLC, 2x500MW Neyveli New Thermal Power Project (NNTPP), Tamilnadu, India.

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The Contractor shall arrange to despatch the following documents to:
PROJECT MANAGER – NNTPP, NLC LTD, 2x500 MW NEYVELI NEW THERMAL POWER PROJECT, NEYVELI - 607 801, TAMIL NADU, INDIA

(a). One (1) original and five (5) copies of the clean rail/lorry receipt. In case of non availability of Original Rail / Lorry receipt, 65% payment shall be released, on receipt of materials at site.

(b). One (1) original and five (5) copies of Contractor's signed invoice.

(c). 6 (six) copies of Challan and Packing List.

(d). 6 (six) copies of inspection certificate, if any issued by the Purchaser.

(e). 6 (six) copies of Purchaser's dispatch clearance

(f). 6 (six) copies of Approved Test Certificates if any.

The RR/Challans duly endorsed by the Purchaser will be handed over to the Contractor for taking delivery of materials from Railway/Trucks unloading the same from wagons/ trucks and subsequent handling, transportation and storage at site after submission of custody-cum-indemnity bond in Purchaser's approved proforma. The demurrage charges, if any, will be payable by the Contractor.

2. By Wagons

In case of despatch of materials in railway wagons, the Contractor shall ensure that the following are observed by them and their Sub-Contractors.

(a). Identify, place necessary indents on the railways and obtain at the appropriate time the correct type of wagons required, keeping in view the consignments to be despatched.

(b). In case of over dimensioned consignments, the Contractor shall obtain the sanction for movement of the O.D. Consignment from the railways.

(c). Non-availability of special wagon or handling equipment shall not be an excuse for payment of demurrage and if so it shall be to the Contractor's account.

(d). Care being taken to avoid all possible chances of damages during transit and to ensure that all packages are firmly secured.

(e). The destination shall be clearly marked.

3. By Road

In case of the consignments despatched by road, the Contractor shall ensure that the following are observed by himself and the Sub-Contractors:

(a). Identify and obtain the correct type of trucks/trailors, keeping in view the nature of consignments to be despatched.

(b). Care being taken to avoid all possible chances of damages during transit to ensure that all packages are firmly secured. .

(c). In case of over dimensioned consignments, the Contractor shall obtain the sanction for movement of the O.D. Consignment. Contractor shall make all out efforts to obtain the required sanctions. However, in case there is a ban on movement of such consignments by Central / State

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Govts. or any other statutory body, the implication of the same on deliveries shall be mutually discussed and agreed.

(d). Non-availability of special trucks or handling equipment shall not be an excuse for payment of demurrage and if so shall be to the Contractor's account.

(e). All consignment despatched by road shall be on "door delivery" and freight paid basis.

(f). The destination shall be clearly marked.

10.10 Packing, Identification and Markings

1. The Contractor shall include and provide for securely protecting and packing the materials so as to avoid loss or damage during handling & transport by air, sea, rail and road.

2. All packing shall allow for easy removal and checking at site. Special precaution shall be taken to prevent rusting of steel and iron parts during transit by sea. Gas seals or other materials shall be adopted by the Contractor for protection against moisture during transit.

3. The number of each package in a shipment shall be shown in fraction, numerator showing number of the package and the denominator showing total number of packages in a lot / consignment. The packages number shall be generally prepared in the sequence in which they will be required for erection.

4. Each package delivered under the Contract shall be marked by and at the expense of the Contractor and such marking must be distinct and in English language (all previous irrelevant markings being carefully obliterated). Such marking shall show the description and quantity of contents, the name and address of consignee, the gross weight and net weight of the package, the name of the Contractor with a distinctive number of mark sufficient for purposes of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and indelibility. Each equipment or parts of equipment shall, when shipped or railed or otherwise despatched be tagged with reference to the assembly drawings and corresponding part numbers. Each bale or package shall contain a packing note quoting specifically the name of the Contractor, the number and date of contract and the name of the office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the part numbers with reference to the assembly drawing and the quantity of each part, drawings nos. and tag numbers.

5. Rotor bearings should not be used as a support while packing.

6. Besides wherever necessary, packing shall bear a special marking "TOP", "BOTTOM", "DO NOT TURN OVER", "KEEP DRY", "HANDLE WITH CARE", etc.

7. All packing cases, containers (excluding marine container), packing and other similar materials shall be new.

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8. Notwithstanding anything stated in this clause, the Contractor shall be entirely responsible for loss, damage or depreciation or deterioration to the materials & supplies due to faulty and/or insecure packing.
9. One copy of respective standard manufacturer's erection instruction/operation instruction manual shall be kept in each package/container for immediate reference.
10. Each and every package box shall be marked with the following, as a minimum:
    (i). Name and address of Consignee :
    (ii). Project reference :
    (iii). Contract No.:
    (iv). Packing No.: (1/10, 2/10, 3/10 ..... when there are 10 packages for one consignment)
    (v). Net Weight/Gross Weight :
    (vi). Port of Loading :
    (vii). Destination Port : Chennai
    (viii). Packing Mark : [symbols indicating "TOP" and other special markings as per clause 10.10.(4) & 10.10.(6) above]
    (ix). Type of Equipment :
    - "E" (for Equipment supply)
    - "T" (for Tools & Tackles)
    - "S" (for Mandatory Spares)

10.11 Type, Quality of Materials and Workmanship

1. The Contractor shall be deemed to have carefully examined and to have knowledge of the equipment, the general and other conditions, specifications, schedules, drawings, etc. forming part of the Contract and also to have satisfied himself as to the nature and character of the work to be executed and the type of the equipment and duties required including wherever necessary of the site conditions and relevant matters and details. Any information thus procured or otherwise obtained from Purchaser/Consultants shall not in any way relieve the Contractor from his responsibility and contractual obligations for designing, manufacturing and supplying the Plant and Equipment at site and executing the work in terms of the Contract. If the Contractor shall have any doubt as to the meaning of any portion of the Contract, he shall before signing it set forth the particulars thereof and submit to Purchaser in writing in order that such doubt may be removed.
2. The Equipment under scope of supply shall be of the best quality and workmanship according to the latest engineering practice and shall be manufactured from materials of best quality considering strength and durability for their best performance. All material shall be new. Substitution of specified material or variation from the method of fabrication may be permitted with the prior written approval of the Purchaser.

3. The Contractor shall procure and/or fabricate all materials and equipment in accordance with all requirements of Central and State enactments, rules and regulations governing such work in India and at site. This shall not be construed as relieving the Contractor from complying with any requirement of Purchaser as enumerated in the Contract Specifications which may be more rigid than and not contrary to the above mentioned rules, nor providing such construction as may be required by the above mentioned rules and regulations. In case of variance of the Contract Specification from the laws, ordinance, rules and regulations governing the work, the Contractor shall immediately notify the same to the Purchaser. It is the sole responsibility of the Contractor, however, to determine that such variance exists. Wherever required by rules and regulations, the Contractor shall also obtain the Boiler Inspector's/ Central Electrical Authorities / Statutory Authorities' approval for the plant, machinery and equipment to be supplied by the Contractor.
4. Codes and standards referred in Contract documents shall be followed. Codes and standards of other countries can be followed with the prior written approval of Purchaser, provided materials, supplies & equipment according to the standard are equal to or better than the corresponding standards specified in the Contract.
5. All meters, gauges, recorders and other types of indicating, integrating or recording devices shall be calibrated in metric system and degree Celsius. Where vernier attachments are related, English system gearing must be changed to produce result on a true decimal (metric basis). Functional and instruction plate shall be in English language.
6. Brand names mentioned in the Contract documents are for the purpose of establishing the type and quality of products to be used. The Contractor shall not change the brand name and qualities of the bought-out-items without the prior written approval of the Purchaser. All such products and equipment shall be used or installed in strict accordance with original manufacturer's recommendations, unless otherwise directed by the Purchaser.

10.12 Drawings and Documents

The Contractor shall supply all drawings and documents to the Purchaser/Consultants as per respective volumes of Technical Specifications.

10.13 Errors and Omissions

1. The Contractor shall be responsible for any discrepancies, errors and omissions in the drawings, documents or other information submitted by him, irrespective of whether these have been approved, reviewed or otherwise accepted by the Purchaser or not.
2. The Contractor shall take all corrective measures arising out of discrepancies, errors and omissions in drawings and other information referred in above para within the time schedule and without extra cost to the Purchaser.
3. The Contractor shall also be responsible for any extra cost and the cost due to delay, if any, in carrying out engineering and site works by other agencies arising out of discrepancies, errors and omissions stated above as well as of any late revision/s of drawings and information submitted by the Contractor.

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10.14 Acceptance of the System

10.14.1 Mechanical Completion

1. On completion of erection of all the materials / items of equipment covered under the scope of the Contract, a joint inspection shall be carried out by the Purchaser and the Contractor to verify physically that all materials /items / equipment have been placed and erected properly and the system is ready for commissioning. A defects list shall be prepared jointly.
2. On liquidation of the defects (except minor defects which shall be mutually discussed and agreed between the Purchaser and Contractor and which shall not affect the commissioning of the system), Mechanical Completion Certificates shall be issued by the Purchaser.

10.14.2 Commissioning & PG Testing

1. Commissioning shall include preliminary operation, initial operation, and successful completion of trial operation.
2. Preliminary operation shall mean all activities after mechanical completion upto commencement of initial operation and shall include mechanical and electrical checkouts, calibration of instruments and protection devices, commissioning of sub/supporting system and static chemical cleaning of the Plant/System/Equipment covered under the Contract.
3. Initial operation shall mean all activities after completion of preliminary operation up to commencement of trial operation and shall be the integral operation of the complete System / Equipment covered under the Contract which shall include no-load / partial load / full load runs for mechanical/electrical try-out and gathering of operational data calibration setting and commissioning of control systems and shut-down inspection and adjustment after running trial of the System / Equipment covered under the Contract.
4. The initial operations Shall include operation of unit as a whole under normal operating conditions on plant automation system for twenty four (24) consecutive hours at the 100% TGMCR load or twelve (12) consecutive hours for two (2) consecutive days at the 100% TGMCR load unless otherwise agreed to by the Purchaser /Consultant or restricted by system load conditions.
5. After initial operation the Contractor has to intimate the Purchaser in writing regarding the readiness of the system for trial operation at least one week before commencement of trial operations. However, Contractor has to furnish sufficient records/documents to satisfy the Purchaser that all the equipment including services, auto loops and instrumentations are tested and ready for trial operations.
6. After the initial operations, the plant shall be on trial operation. During the trial operation, the Contractor shall be allowed to make minor adjustments as may be necessary, provided that such adjustments do not interfere with or prevent the commercial use of the plant or result in significant reduction of output or increase of the heat rate of the plant. For the period of trial operation the time of actual operation shall be counted.

The plant shall be under 'Trial operation' by the contractor for a period of 30 days, during which it shall be operated continuously/ intermittently at any unit load up to maximum capacity of 500 MW as desired by the purchaser. The trial operation will also include 72 hours of continuous operation on full load for the entire system. The maximum number of interruption attributable to CONTRACTOR will be four (4) numbers each not exceeding four (4) hours duration. In case within first four days of reliability operation either the number of interruptions, attributable to the CONTRACTOR exceeds four (4) or the duration of any of the four (4) interruptions exceeds four (4) hours, the Trial Operation will be repeated. Beyond four days, the Trial Operation will be extended for the corresponding period of interruptions of more than eight hours. After a cumulative 30 days of safe, stable Trial Operation, the Steam Generators will be Provisionally Taken Over by the Purchaser. The period of trial operation may be reduced, if so, as desired by the Purchaser. During trial operation, the contractor shall post sufficient number of qualified personnel.

The onus of proving that any failure is not due to faulty design, materials and workmanship shall lie with the Contractor

7. A 'trial operation' report comprising observations and recordings of various parameters measured in respect of the 'reliability operation' shall be prepared and submitted to the Purchaser /Consultant. This report, besides recording the details of various observations during 'trial operation' shall also include the dates of start and finish of the trial operation and shall be signed by the representatives of both the parties. The report shall have recordings of all details of interruptions that occurred, adjustments made and any repairs done during the 'trial operation'. The 'trial operation' shall be considered successful, provided that each item of plant can meet the above requirements.

8. On successful completion of trial operation, the unit shall be Provisionally Taken over with a list of major and minor defects and non conformities prepared jointly by the Purchaser and the Contractor. Differentiation of defects as major and minor shall be jointly discussed and agreed by the Purchaser and Contractor and recorded. Upon the completion of ' trial operation', as soon as practicable, or at such time as may be otherwise agreed to by the parties concerned, the Contractor Shall notify in writing to the Purchaser /Consultant that the plant is ready for performance tests only after liquidating all the major defects.

9. Readiness for "Performance Test" shall be intimated to the Purchaser in writing at least 15 days before commencement of "Performance Test". However, Contractor shall be allowed to conduct "Performance Test" only after liquidating all the major defects.

10. The performance tests shall be conducted at site for each unit and all major systems by the Contractor. The Contractor's commissioning Engineers Shall make the plant ready for such tests and assist the Purchaser in operation during the tests. The test shall be commenced after the 'Plant / Equipment' has attained stable operation The date of commencement of the performance tests shall be after completing trial operation and after attending all the

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pending works if any and major/minor defects or as may be mutually agreed upon between the Contractor and Purchaser. The defects / non-completion of work which will directly affect the power generation, performance / safety of the equipment, safety of the personnel will be included under major defect / major work and the other will be included in the minor defect / minor work. The performance test shall be conducted before the end of the third month from the date of completion of trial operation. The tests shall be binding on both the parties of the 'Contract' to determine compliance of the 'Plant' / 'Equipment' with the performance guarantees. The purpose of the performance tests is not only to check whether the plant meets the guaranteed performances but also provide a full mass, heat and energy balance for the whole plant which shall serve as reference to evaluate the plant performance in future over the plant life.

11. Performance Guarantee Test of each Steam Generator required to be conducted within three months from the date of "Provisional Take Over" of respective Steam Generator. In case the Performance Test is conducted beyond three months for reasons attributable to the Contractor, ageing factor shall not be considered during "Performance Test". However, the contractor has to complete the performance guarantee test within one year from the date of provisional take over, failing which, it shall be construed that the guaranteed performance has not been met and liquidated damages for shortfall in performance shall apply in full subject to the condition that delay in carrying out performance guarantee test is attributable to the contractor. However, the purchaser shall retain the option to reject the equipment, if necessary. Results of the Performance Test shall be submitted within 15 days of completion of performance test to the Purchaser for review and approval. The approval shall be given within 30 days of submission of results.

12. The performance test procedure, including the definition of the calculation method to be used, the instrumentation to be installed and indicated in the schemes, the instrument accuracy classes, the areas of responsibility and the items which specifically require preparation and agreement Shall be submitted by the Contractor for review and approval by the Purchaser /Consultant during detail engineering phase. Schematics identifying the guarantee test instrumentation shall be submitted along with procedure. It shall be ensured that necessary test points and spool pieces are indicated in the schemes during the detail engineering phase and also identified in process and instrumentation drawings. Contractor shall furnish detail program during detail engineering stage.

13. The performance test instruments shall be of precision type with instrument accuracy limits as required and defined in the applicable performance test codes such that measurement uncertainty does not exceed the values agreed to by the Contractor in the Schedule of Performance Guarantees. The performance tests shall be carried out as per test codes agreed in schedule of performance guarantees.

14. All test instrumentation for the performance tests as required shall be supplied by the Contractor on loan basis. Data loggers on loan basis shall be used extensively for SG tests. All costs associated with the supply,

calibration, installation and return of the test instrumentation / data loggers / computers etc. are deemed to have been included in the contract price. The test shall be in accordance with those specified or as per agreed performance test codes. Batch calibration shall not be accepted.

15. Any special equipment, tools and tackles required for successful completion of the performance tests shall be provided by the Contractor.

16. It is the Contractor's responsibility to co-ordinate for suitably carrying out the performance tests. The duration of the test wherever not indicated shall be in accordance with the agreed test codes at the loads after necessary stabilising period to obtain steady state conditions. All other tests to prove the guarantees as indicated in the Contract shall also be conducted.

17. The plant parameters during the performance test shall be adjusted as far as practicable to the guaranteed performance test conditions. The tests shall be conducted to prove guaranteed parameters as defined in the specification.

18. The performance test results shall be reported as computed from the performance test observations with corrections for site conditions, variations in fuel, etc. and test conditions. Such correction curves shall be finalised during Detail Engineering at least six (6) months before start of PG test. No additional allowances for errors in measurement are permissible.

19. Within 4 (four) weeks after the conclusion of the performance test and unit characteristics tests, the Contractor shall submit a test report to the Purchaser with a copy submitted to the Consultant stating:

    (a). In the case of a performance test, whether the unit passed or failed such test, accompanied by sufficient test data and calculations to demonstrate the level of performance attained with respect to each of the tested parameters.

    (b). In case of a unit characteristics tests, the level of performance achieved with respect to the desired levels of performance.

    The report(s) shall include as a minimum, the following:

    (i). Description of the test procedures
    (ii). Standards that were used
    (iii). Instrumentation details and calibration
    (iv). Full schematic diagrams with indication of instrument test location and identification tag of same.
    (v). Test logs and summary of test readings used for performance calculations
    (vi). Full set of correction curves
    (vii). Computation of test results.
    (viii). Conclusions of performance tests : test passed or not

20. Within thirty (30) days of receipt such test report(s), the Purchaser shall submit a notice to the Contractor with a copy submitted to the Consultant, stating either:

    (i). That Purchaser concurs with the information provided in the Contractor's test report(s), or

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(ii). That Purchaser disputes some or all of the information provided in the Contractor's test report(s), the areas being disputed, and the levels of performance being disputed.

21. If Purchaser disputes any or all of the results contained in the Contractor's test report(s), representatives of the Contractor, Purchaser and the Consultant shall meet after the receipt of the Purchaser's notice at a mutually acceptable date & location to review and discuss the dispute.

22. In relation to each unit, the Contractor shall give to the Consultant and Purchaser 21 (twenty one) days' notice of the date after which he shall be ready to make the tests and the Contractor shall commence the tests promptly thereafter. Any data obtained in respect auxiliary power consumption prior to the commencement of the Tests in relation to the Performance Guarantees shall not be used to assess whether the Performance Guarantees have been attained.

23. If the tests could be carried out but are being unduly delayed by the Contractor the Purchaser may, by notice require the Contractor to make the tests within 14 days after the receipt of such notice. The Contractor shall make the tests on such days within that period as the Contractor may fix and of which he shall give notice to the Purchaser.

24. If the Contractor fails to make the tests within 21 (twenty one) days of such notice the Purchaser may himself proceed with the tests. All tests so made by the Purchaser shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from the contract price or charged to the Contractor. The tests shall then be deemed to have been made by the Contractor.

25. If any unit fails to pass the test (which in the case of performance tests means not achieving the acceptable limits), the Purchaser may require/allow such tests to be repeated on the same terms and conditions save that only reasonable notice of the date and time of such tests shall be required to be given by the Contractor to the Purchaser.

26. If the Purchaser /Consultant and the Contractor disagree on the interpretation of the test results, each shall give a statement of his views to the other within 14 (fourteen) days after such disagreement arises. The statement shall be accompanied by all relevant evidence. If Purchaser disputes any or all of the results contained in the Contractor's test report(s), representatives of the Contractor, Purchaser and the Consultant shall meet after the receipt of the Purchaser's notice at a mutually acceptable date & location to review and discuss the dispute. Mutual discussions will be held and agreed to determine the interpretation of the test results.

27. On successful completion of Commissioning & PG testing of the system as described above and on completion of entire Supplies including spares and new set of tools and tackles as per the Contract, the Commissioning Certificate shall be issued by the Purchaser.

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10.14.3 Final Take Over

1. After successful completion of Performance Test of the unit(s), the Steam Generators shall be taken over and the guarantee period starts from this date of Final Take Over.
2. Till the 'Final Take Over' the Contractor shall provide qualified personnel to guide the Purchaser's personnel.
3. Any non-conformity arising in the system and any rectification in the dismantling works till 'Final Take Over' shall be rectified by the Contractor at his own cost Purchaser shall not be held responsible for any such non-conformities arising during this period.
4. Purchaser reserves the right to declare the commencement of commercial operation at his discretion on any day after successful completion of trial operation. The Contractor shall not be absolved of his responsibilities for the reason being the commercial operation has started.
5. In case any stoppages are required for repairing/ replacing the parts of the system by the Contractor, the Purchaser shall release the system for such repairs/ replacement within a reasonable time.
6. Certificate for "Final Take Over" shall be issued by the Purchaser when
   (a) All supplies and services have been completed as per Contract.
   (b) The Contractor has met any and all obligations under this Contract.
   (c) Final balance documentation, if any, incorporating latest modifications in 'as built' drawings has been submitted by the Contractor in requisite copies.
   (d) The Contractor has rectified in a definite manner all objections / observations mentioned in the "Commissioning Certificate" and 'Final Project Punch List'

10.15 Mandatory Spares, Tools & Tackles and Consumables

10.15.1 Mandatory Spares: Intentionally deleted.

10.15.2 Tools and Tackles: Intentionally deleted.

10.15.3 Initial Fill, Oil, Lubricants & Consumables: Intentionally deleted

10.16 Approval by the Purchaser

1. Documents and drawings as mentioned in Schedule-4 shall be subject to the approval of the Purchaser/ Consultant.
2. Other drawings and documents as per Schedule-4 shall be subject to the review and reference of the Purchaser/ Consultant.
3. All changes from the approved drawings/documents shall be subject to the prior approval of the Purchaser / Consultant.
4. All sub-contractors and sub-suppliers for raw materials testing, design and engineering, manufacture, supplies, construction and erection work and any other work/services covered under the Contract shall be subject to the written approval of the Purchaser / Consultant.
5. While the Contractor shall make/execute/perform supplies, work and services in terms of the Contract, the Purchaser shall have the right to check and

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approve design, type, quality, quantity, materials and workmanship of any or all items of supplies, work and services where considered necessary by the Purchaser to ensure that supplies, work and services made/executed/ performed by the Contractor are in accordance with the provisions of this Contract.

6. The Chief Project Manager of Contractor who shall be in overall charge of the Project at site shall be appointed in consultation with the Purchaser.
7. Detailed assignment schedules of foreign Experts/ Specialist for rendering technical services shall be submitted by the Contractor for the approval of the Purchaser within six months from the date of LOA. The bio-data of key personnel shall be submitted within two months of the date of LOA and for others six months before their deputation.
8. To enable the Purchaser to accord approval and to review documents and drawings the Contractor shall submit back-up data/ drawings/basic calculations/assumptions as may be required by the Purchaser/ Consultant.
9. Where approval of the Purchaser/Consultant is required or implied but is not specifically provided for elsewhere in this Contract, such approval shall also come within the purview of this schedule.
10. Approval by the Purchaser/Consultant in terms of this schedule shall not relieve the Contractor of any of his obligations under the Contract. The Purchaser/ Consultant shall approve within 30 (thirty) days or refuse approval within 15 (fifteen) days from the date of receipt of request with supporting documents.
11. The approval requested by the Contractor shall not be withheld unreasonably by the purchaser. All requests for approval shall be accompanied by fully supporting documents, otherwise it shall not be considered as a request.

10.17 Sub-Contract

1. The Contractor shall not sub-contract the Contract Work in whole to third parties for the performance of this Contract.
2. The Contractor may propose a panel of Sub- Contractors for the part of scope of works. The Contractor shall thereafter select any sub-Contractor out of this panel subject to the approval of the Purchaser. Any such assignment shall not relieve the Contractor from any obligation, duty or responsibility under the contract. Any assignment as above without the prior concurrence of the Purchaser shall be void.
3. The Contractor shall be responsible for transmitting all the pertinent data of all Contract terms and conditions with his Sub-Contractors. The Contractor shall also furnish the specification, place of manufacture, delivery schedule and adequate, unpriced copies of supply orders/contract he has entered into in respect of imported items and adequate copies of un-priced supply order/contract in the case of indigenous items.
4. The Purchaser shall give approval or shall refuse approval in writing within 30 days of receipt of request along with all supporting details.
5. Bought-out items, critical components, proprietary items and equipment manufactured and supplied by specialised manufacturers which the

Contractor intends to incorporate in the Contract Work shall also be subject to the written approval of Purchaser

6. The approval extended by the Purchaser in selecting Sub-Contractors recommended by the Contractor shall not discharge the later from his Contract obligations. The Contractor shall remain solely liable for any action, deficiency, and/or negligence on the part of his Sub-Contractors/sub-suppliers.
7. In the event certain obligations extended by a Sub-Contractor to the Contractor should extend beyond the guarantee period specified in the Contract, the Purchaser shall automatically be entitled to the benefit thereof.
8. In no event shall the Purchaser be deemed to have any Contractual obligations whatsoever in respect of Contractor's/ Sub-Contractors and/or title-holders of any sub-orders placed by the Contractor.

10.18 Inspection and Tests at Contractor's/ Manufacturer's Premises

1. The Purchaser or his authorised agent shall have the right of inspecting and testing the contract work or any part thereof at any stage during the manufacture and the Contractor on demand from the Purchaser shall carry out such tests in appropriate manner in the presence and free of charge to Purchaser. The tests required as per relevant codes and the tests specifically agreed in the contract specifications and agreed QAP only will be done. Should the Contractor himself not be in a position to carry out the tests, he shall, on the Purchaser's demand prepare specimen and samples and send them at his own cost to such testing stations as the Purchaser may specify and the cost of the test so effected shall be to the Contractor's account. However, cost pertaining to the Purchaser's inspection personnel shall be borne by the Purchaser.
   (i). Should a part of the plant be manufactured not on Contractor's own premises but on other premises, the Contractor shall likewise obtain permission for the Purchaser/his authorised representative to inspect and test the work as if the said plant were being manufactured on the Contractor's premises.
   (ii). The inspection, examination or testing carried out by the Purchaser shall not relieve the Contractor from any of his obligations under this Contract. The inspection procedure shall be discussed and finalised.
2. The inspection and tests shall be so conducted as not to unreasonably impede the progress of manufacture.
3. The Purchaser shall have the right to be present during all tests carried out by the Contractor. The Contractor on being requested so to act, shall present sufficient documentary evidence that the material used shall meet the specified requirement. If called for, samples and specimen shall become the Purchaser's property. The Contractor shall notify the contract work, particularly before any assembly, in order that the inspection or tests can be carried out as may be required to ascertain without prejudice to the Contractor's liability, whether the materials and/or services are in conformity with the requirement of the contract. All inspection and tests shall be carried out as per the approved procedure unless otherwise specified.

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4. The Contractor shall bear all costs of any and all agreed inspections and tests. If special tests are necessary based on the results of the agreed test, then cost of all such special tests also shall be to the account of the Contractor in all cases.

5. The Purchaser upon giving 15 (fifteen) days notice in writing and stating any grounds of objection, shall have the right to reject any or all equipment or demand rectification or replacement thereof.

6. The Contractor shall submit to the Purchaser quarterly programme of inspection and tests one month in advance of the commencement of the quarter. The Contractor shall give the Purchaser a minimum of 15 (fifteen) days clear notice for inspection within India and 30 (thirty) days clear notice for inspection at places other than India, of any work being ready for inspection and tests specifying the period likely to be required for such inspection and tests. Thereafter, the Purchaser or his inspector shall, unless inspection or test is voluntarily waived, attend at the contractor's or his Sub-supplier(s)/Sub-contractor(s) premises, such inspection and tests within 7 (seven) days of the date on which the equipment is notified as being ready for inspection and test. Should the Purchaser fail to attend such inspection and test, the Contractor may proceed with the inspection and test at his option which shall be deemed to have been made in the Purchaser's presence and shall forthwith forward to the Purchaser copies of inspection/test certificates for acceptance by the Purchaser. The pro-forma and number of copies for inspection/test certificates shall be mutually agreed. However, if the Purchaser request the Contractor for a revised date of inspection but within 15 days of the date of inspection as communicated by the Contractor, the Contractor shall arrange the inspection on the revised date as requested by the Purchaser.

7. In all cases whether at the premises or works of the Contractor or of any sub-contractor, the Contractor shall, provide free of charge to the Purchaser such labour, materials, electricity, fuel, water, stores, apparatus and instrument and/or facilities as may reasonably be deemed required to carry out efficiently such tests of the plant in accordance with the contract and shall give all such facilities to the Purchaser or his authorised representative to accomplish such tests.

8. When the inspection/tests have been satisfactorily completed at the Contractor's or his Sub- Contractor's premises, the Purchaser shall issue a certificate to that effect. If a final certificate can not be issued, a provisional certificate shall be issued. If the tests were not witnessed by the Purchaser or his representative the certificate shall be issued on receipt of the inspection and tests report from the contractor but not later than 15 (fifteen) days after the receipt of the said report by the Purchaser. In the event a certificate is not issued by the Purchaser during 15 (fifteen) days, the Contractor, if considered necessary, can arrange despatch along with the certificate as stated in 10.18.6 with the clear understanding that if the Purchaser reject such equipment at a later date, the contractor shall rectify the same at his own cost to the Purchaser's satisfaction. No Plant shall be shipped or left or otherwise despatched before such certificate has been

issued. The satisfactory completion of these inspection and tests or the issue of the certificate shall not bind the Purchaser to accept the work, should it on further tests during or after erection be found not to comply with the Contract.

9. In case any equipment fails in inspection/tests, re-inspection/retest shall be carried out only after necessary rectification work/replacement by the Contractor.

10. Subject to Clause-10.18.8 above, no plant, equipment and material shall be shipped before inspection certificate and despatch instructions have been issued by the Purchaser.

11. The contractor shall furnish to the Purchaser/his authorised Inspector five (5) copies of un-priced purchase orders including detailed technical specification and drawings placed on his Sub- Contractors as soon as such orders are placed by the Contractor, but in any case not later than two (2) months before the expected date of the equipment getting ready for inspection.

12. In the case of mandatory spares and recommended spares, the same shall be offered for inspection along with the main equipment or after the main equipment has been satisfactorily inspected and tested.

13. In the case of such equipment, structural etc. where tests set forth above cannot be conducted either partially or fully in Contractor's/Sub-supplier(s) premises but have to be conducted at site only after erection, the provisions under this schedule shall also apply. However, in such cases prior approval of the Purchaser shall be obtained by the Contractor prior to despatch.

10.19 Participation of Indian Engineers

1. For basic design and detail engineering of Plant & Equipment, if carried out by the Contractor in his office abroad, Purchaser reserves the right to depute his/Consultants' or engineers hereafter called Indian Engineers to participate in this work.

2. The participation assignment, number of Indian engineers, their technical disciplines and the period of participation shall be mutually agreed.

3. The Contractor shall provide all opportunities and information to Indian engineers to get acquainted with the technical know-how and the methods and practices adopted by the Contractor in basic and detail engineering. The Contractor shall provide documents, drawings, calculations etc. as may be required by Indian engineers.

4. The Contractor shall provide free of charge office accommodation, office facilities, secretarial services, communication facilities, general and drawing office stationary, etc as may be reasonably required by the Indian engineers. Similarly, facilities shall also be provided by Contractor's /Sub-Contractors/ Associates if such basic and detail engineering activities are carried out in the design offices of Sub-Contractors/Associates.

5. At all times the Indian engineers shall remain employees of the Purchaser or Consultant as the case may be.

6. The Purchaser shall bear all costs relating to air fares, local travel, residential accommodation and subsistence in respect of Indian engineers.

7. In the absence of designation as Purchaser's or Consultants' representative, no such Indian engineer shall have any authority under the Contract.

10.20 Standards, Codes and Compliance with Laws & Regulations

1. The design, engineering, manufacturing, supplying, assembling, erection, testing and construction work shall be carried out in accordance with latest appropriate Indian Standards and Codes unless otherwise specified in the Contract specification. Where appropriate Indian Standards and Codes are not available, appropriate latest standards and codes of Country of Origin shall be used. Contractor shall however, obtain purchaser's prior approval before using such standards and codes of country of origin.

2. The Contract Work shall be designed to suit the climatic, geological, hydrological, hydro-geological, and seismological and soil conditions of the site. Measures shall be taken against corrosion/erosion by ground water, storm surge, floods, cyclones, wind speeds etc.

3. The Contractor shall, throughout the performance of this Contract comply with all laws, rules, regulations and statutory requirements of Government of India, Government of Tamil Nadu and other statutory bodies as far as such bodies have jurisdiction over the Contract work or any part of the site.

4. If any new statutory regulation or law or modification of the existing regulation or law comes into force subsequent to the Base Date, the Contractor shall comply with the same. However, if it calls for any modification of the design/equipment with financial implication, the same shall be discussed between the Contractor and Purchaser and mutually agreed.

10.21 Protective Painting

The General Specification for painting and colour code etc shall be followed by the Contractor for painting of equipment, steel structures etc. as per the technical specification.

10.22 Weights & Measures

1. All weights, dimensions and measures shall be in metric system.

2. All weights, instruments, measures used in the contracted equipment shall be properly calibrated.

10.23 Secrecy, Titles

1. All maps, plans, drawings, specifications, schemes and the subject matter contained therein and all other information given to the Contractor by the Purchaser in connection with the performance of the Contract Work shall be held confidential by the Contractor and shall remain the property of the Purchaser and shall not be used or disclosed to third parties by the Contractor for any purpose other than for which they have been supplied or prepared. The Contractor may disclose to third parties, upon execution of secrecy agreements, such part of the drawings, Specifications or information if such disclosure is necessary for the performance of the Work.

2. Maps, layouts and photographs of the unit/integrated Thermal Power Station including its surrounding regions showing vital installation for national security of Purchaser's country shall not be published or disclosed to the third parties or taken out of the country without prior written approval of the Purchaser.

3. Title to secret processes if any developed by the Contractor on an exclusive basis and employed in the design of the equipment shall remain with the Contractor. The purchaser shall hold in confidence such processes and shall not disclose such processes to the third parties without prior approval of the Contractor.

4. Subject to above Clause, title to technical specifications, drawings, flow sheets, norms, calculations, diagrams, interpretations of test results, schematics, lay-outs and such other information which the Contractor has supplied to the Purchaser under the Contract shall be passed on to the Purchaser. The Purchaser shall have the right to use these for construction, erection, start-up, commissioning, operation, maintenance, modifications and/or expansion of the works including for the manufacture of spare parts in connection with the project.

5. The provision of above Clauses shall not apply to information:

   (i). Which at the time of disclosure are in the public domain or which later on become part of public domain through no fault of the party concerned, or

   (ii). Which were in the possession of the party concerned prior to disclosure to him by the other party, or

   (iii). Which were received by the party concerned after the time of disclosure without restriction on disclosure or use, from a third party.

10.24 Rejection of Defective Plant & Works or Other Installation

1. If the completed plant, or any portion thereof, before it is finally accepted be found to be defective or fails to fulfil the requirements of the Contract, the Purchaser shall give the Contractor notice setting forth particular of such defects or failure and the Contractor shall forthwith make the defective plant good, or alter the same to make it comply with the requirements of the Contract. Should he fail to do so within a period of time as deemed reasonable by the Purchaser and stated in the said notice, the Purchaser may reject and replace at the risk and cost of the Contractor, the whole or any portion of the plant, as the case may be, which is defective or fails to fulfil the requirements of the Contract. However, such rejection/replacement by the Purchaser shall not absolve the Contractor of any of his responsibilities under this Contract.

2. Without prejudice to the above, the Purchaser shall be entitled at his discretion to the use of the rejected plant in a reasonable and proper manner for a time reasonably sufficient to enable him to obtain other replacement plant. However, such usage shall not be deemed as waiver or acceptance of such defective plant by the Purchaser.

10.25 Negligence

1. If the Contractor shall neglect to execute work with due diligence or expedition or shall refuse or neglect to comply with any reasonable order given to him in writing by the Purchaser in connection with the work or shall contravene the provisions of Contract, the Purchaser may give notice in writing to the Contractor calling upon him to make good the failure, neglect or contravention complained of within such time as may be deemed reasonable by the Purchaser and in default of compliance with the said notice, the Purchaser without prejudice to its rights under clauses 10.25 (2) hereto and Cl. 6.6.9, may rescind or cancel the Contract as provided in Cl.10.30 holding the Contractor fully liable for the damages that the Purchaser may sustain. In addition, the Contractor shall refund all amounts paid to him by the Purchaser for all such work which, may become infructuous due to such cancellation.
2. Should the Contractor fail to comply with such notice within the period as mentioned in the notice or any other period considered reasonable by the Purchaser for such compliance, from the date of serving thereof, then and in such case, without prejudice to the Purchaser's right under clause 10.25.1 hereto, the Purchaser shall have at his option the right to take the affected work wholly or in part out of the Contractor's hands and may complete the work, as envisaged in the Contract either departmentally or by awarding fresh Contract(s) at a reasonable price to any other persons or firm or company to execute the same, at the cost of the Contractor.
3. In such event the Purchaser shall, without being responsible to the Contractor for fair wear and tear to the same, be entitled to seize and take possession of all materials, construction equipment tools, tackles and other things belonging to the Contractor and also to have free use of all materials, construction equipment, tools, tackles and other things of the Contractor / its sub-contractors which may be on the site for use at anytime in connection with the work to the exclusion of any right of the Contractor over the same and the Purchaser shall be entitled to retain and apply any sum which may otherwise be then due as per the Contract or any other contract from him to the Contractor as may be necessary for the payment of the cost of execution of such work as aforesaid.
4. If the cost of executing the work as aforesaid shall exceed the sum due to the Contractor and the Contractor fails to make good the deficit, the said materials, tools, tackles, construction plant or other things and properties belonging to the Contractor as may not have been used up in the completion of the work, may be sold by the Purchaser and proceeds applied towards the payment of such difference and the cost of and incidental to such sale. Any outstanding balance existing after crediting the proceeds of such sale shall be paid by the Contractor on the demand of the Purchaser, but when all expenses, cost and charges incurred in the completion of the work are paid by the Contractor, all such materials, tools, tackle, construction plant or other things not used in the completion of the work and remaining unsold shall be removed by the Contractor with the written permission of the Purchaser only.

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5. In addition, such action by the purchaser as aforesaid shall not relieve the contractor of his liability to pay LD. for delay in completion of work as defined in Schedule-4.

10.26 Progress Report

1. The Contractor shall prepare and regularly update his detailed PERT/CPM Networks and submit the same with computerized time analysis reports showing starting and completion dates of all activities of engineering, purchasing, procurement of materials, manufacture, supply, inspection and despatch, construction, erection etc. in his scope of work and those of his sub-contractor(s).
2. The Contractor shall submit the progress report in such pro-forma and details as may be required by the Purchaser showing the agreed detailed programme of various activities as per above clauses and actual progress achieved to monitor the progress of the work.
3. The Contractor shall submit the progress report every month and in 15 (fifteen) copies. Purchaser shall have the right to depute his/Consultant's representatives at the premises of works of the Contractor or any of his sub-contractors to ascertain the progress of work.
4. The Contractor shall submit the progress photographs in 10 (ten) copies every month relating to the progress in sequence of work of all major activities.

10.27 Training

1. While basic induction training for all categories of staff and for all job positions shall be provided by the Purchaser, the Contractor shall identify from the manpower requirements, the key positions and number of persons to be trained for efficient running of the plant. Purchaser shall depute personnel with appropriate qualifications and experience for training.
2. The Contractor shall arrange for training of Purchaser's personnel for working procedures and systems covering working norms and quality standards. Such training shall include training in Contractor's design and engineering department and/or in the manufacturer's shop and for operation and maintenance in working plants.
3. The Contractor shall give detailed training programme for Purchaser's personnel, well in advance of their arrival at the place of training. The training programme can be changed by mutual agreement of the parties hereto depending on the requirement. The Contractor shall supply (1 microfilm and 5 copies) all Training Manuals, Instructions and other connected literature in 6 copies to the Purchaser in English Language.
4. In addition, each trainee shall also receive a complete set of such Training Manuals, Instructions and other connected literature.
5. For maintenance personnel earmarked for training with the Contractor, it must be ensured that they are associated during preparation and testing of major assemblies/sub-assemblies at manufacturer's works.
6. The period and the nature of training for the individual shall be agreed upon mutually between the Contractor and the Purchaser. These engineering

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personnel shall be given special training in the shops, where the equipment shall be manufactured and/or in their collaborator's works and where possible, in any other plant where equipment manufactured by the Contractor or his collaborator is under installation or test, to enable those personnel to become familiar with the equipment being furnished by the Contractor.

7. All travelling and living expenses for the engineering personnel of the Purchaser to be trained during the total period of training shall be borne by the Purchaser. The Contractor shall, however, arrange for necessary accommodation and other local and transport facilities free of cost, at the site of training/ manufacturing works for the trainees. However contractor will arrange free accommodation at his manufacturing units subject to availability. These engineering personnel while undergoing training shall be responsible to the Contractor for general discipline. For non-utilization of offered training period, no rebate will be applicable.

10.28 Patents

1. If the performance of the Contract involves the use of a patent, trade mark, registered design, copy rights and/or industrial property rights of which the Contractor holds the title, the Contractor shall not be entitled to any licence fee, royalty and/or compensation from the Purchaser outside of the Contract Price which shall be deemed to include such licence fee, royalty and/or compensation.

2. Where the title holder of a patent, trade mark, registered design, copy rights and/or industrial property rights used is a third party, the Contractor shall be liable for settling with such party and paying any licence fee, royalty and/or compensation thereon.

3. The Contractor shall submit to the Purchaser a certificate from the licensor attesting technology of the licence granted.

4. In the event of any third party raising claim or bringing action against the Purchaser including but not limited to action for injunction in connection with third party's alleged rights affecting the equipment covered under the Contract or the use thereof, the Contractor agrees and undertakes:

   (i). To defend and assist the Purchaser in defending at the Contractor's cost against such third party's claim and/or actions and against any law suits of any kind initiated against the Purchaser.

   (ii). To indemnify, keep indemnified and hold harmless the Purchaser against all actions, claims, demands, costs, charges and expenses raised by third parties and arising from or incurred by reason of any infringement of patent, trade mark, registered design, copy rights and/or industrial property rights by manufacture, sale or use of the equipment supplied by the Contractor whether or not the Purchaser is held liable for by any court judgement. Provided, however, that:

      (a) The Purchaser shall, as soon as reasonably possible notify the Contractor in writing of such third party's claim and/or action and:

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- The Contractor shall at his own cost defend or assist the Purchaser in defending his rights against any such claims and/or actions ;
- If the Contractor defends the case, the Purchaser shall assist the Contractor free of charge by providing all such information and documents as are available with the Purchaser, save and except that in case of production of any witness at the request or insistence of the Contractor shall bear the costs and expenses required in this regard.

(b) The Purchaser shall not without the Contractor's consent (which shall not be unreasonably withheld) enter into any commitment or admit any fact capable of supporting third party's claims, unless the Purchaser shall release the Contractor of his liabilities and obligations.

(c) The Contractor shall at his own cost, without prejudice to the provisions of this Schedule, may either carry out such alterations or modifications of the equipment which are necessary to avoid the infringement without affecting the efficient operation of the equipment to the satisfaction of the Purchaser or to procure a right to the unrestricted use of the infringing equipment by the Purchaser.

5. Nothing in this article shall abrogate or abridge the Contractor's own liability for infringement or violation of patent, trade mark, registered design, copy rights and/or industrial property right of a third party, if such infringement or violation is proved before and sustained in court of law and the Contractor fails to take action in terms of provision of Clause 10.28 (4)

6. If required and mutually agreed, the Purchaser shall enter into Process Licence Contract(s) as per clause 10.28. (2).

7. The rights and liabilities of the parties under this Clause shall survive this Contract.

10.29 Indemnity

1. The Contractor shall at all times indemnify and keep indemnified the Purchaser against all claims which may be made against the Purchaser in respect of any infringement of any rights protected by patent registration of design of trade mark. In this connection, the Purchaser shall pass on all claims made against him to the Contractor for settlement.

2. The Contractor assumes responsibility for and shall indemnify and save harmless the Purchaser from all liability, claims, costs, expenses, taxes and assessments including penalties, punitive damages, attorney's fees and court costs which are or may be required to be paid by the Purchaser arising from any breach of the Contractor's obligations under the Contract or for which the Contractor has assumed responsibilities under the Contract including those imposed under any Contract local or national law or laws, or in respect to all salaries, wages or other compensation or all persons employed by the Contractor or his Sub-Contractors or suppliers in connection with the performance of any work covered by the Contract. The Contractor shall execute, deliver and shall cause his Sub-contractor and suppliers to execute

and deliver, such other further instruments and to comply with all the requirements of such laws and regulation as may be necessary there under to conform and effectuate the Contract and to protect the Purchaser.

3. The Purchaser shall not be held responsible for any accident or damages incurred or claims arising there from during the period of construction and erection under the responsibility of the Contractor/sub-contractors/associates and putting into operation of the plant under the supervision of the Contractor in so far as the latter is responsible. However, the Contractor shall be liable for such accidents as may be due to negligence on his part to carry out work in accordance with Indian laws and regulations.

4. The Contractor shall be responsible for proper fencing, lighting, guarding and watching of all works at site until they are taken over and further arrange proper provisions for like period of temporary drainage, roadways, footways, guards and fences as far as may be rendered necessary by reason of works for accommodation and protection of the Purchaser's adjacent property and that of, the public and others. No naked light shall be used by the Contractor on the site otherwise than in the open air without the special permission in writing from the Purchaser. The purchaser shall not be responsible for any theft or misuse of material/plant, equipment.

10.30 Termination, Suspension and Foreclosure

1. The Purchaser may at any time on breach of this Contract by the Contractor give him a written notice of such breach. If the Contractor does not take appropriate measure to the satisfaction of the Purchaser within a period of 30 days after issuance of such notice to remedy that breach, then the Purchaser may terminate this Contract at any time thereafter stating therein the date of termination. The Contractor shall then be liable to the Purchaser in accordance with the Clause- 10.25 hereinabove.

2. The Purchaser reserves the right to terminate this Contract at any time by giving a notice of not less than 30 (thirty) days without assigning any reason. The Contractor shall stop the performance of the Contract from the Date of termination and hand over all the drawings, documents, plant, equipment, supplies, material etc. including all the rights of work to the Purchaser. The Purchaser shall pay to the Contractor the cost incurred as decided by the Purchaser till the date of termination as compensation. No consequential damages shall be payable by the Purchaser to the Contractor in the event of termination.

   If the contract is terminated due to the default of the Contractor, the initial advance would be deemed as interest bearing advance at an interest rate prevailing as on the date of NIT to be compounded quarterly.

3. The Purchaser may suspend the work in whole or in part at any time by giving Contractor notice in writing to such effect stating the nature, the date and the anticipated duration of such suspension.

4. On receiving the notice of suspension as per above clause, the Contractor shall stop all such work which the Purchaser has directed to be suspended with immediate effect. The Contractor shall continue to perform other work in terms of the Contract which the Purchaser has not suspended.

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5. The Purchaser may at anytime cancel the suspension notice for all or any part of suspended work by giving written notice to the Contractor specifying the part of work to be resumed and the effective date of suspension withdrawal. The Contractor shall resume the suspended work as expeditiously as possible after receipt of such withdrawal of suspension notice.
6. In the event of suspension of work, the Purchaser shall not be liable to the Contractor for any damage or loss or idle labour caused by such period of suspension of work. The Purchaser shall not be liable to Contractor for any payment towards watch & ward and any other expenditure

   However, the compensation for the suspension period beyond 60 days in aggregate, for the reasons attributable to the Purchaser, shall be mutually discussed and agreed. Further for the actual suspension period, for the reasons attributable to the Purchaser, which will affect the progress of Contractor's work and the scheduled completion time, the extension of time, shall be granted, on request from the Contractor.
7. The contract shall be terminated if due to any unforeseen circumstances which may lead to the foreclosure of the project for reasons such as resource crunch, non-availability of funds, and for other administrative resource etc. Purchaser shall however, give 60 days prior written notice to the contractor of the effective date of termination.
8. Contractor shall be compensated only for the quantum of work/services he has rendered till effective date of foreclosure. Any other claims like compensation for loss in profit, compensation for loss of reputation etc. or any other consequential damages if any claimed by the Contractor shall not be given by the Purchaser.

10.31 Termination of Services of Contractor's Personnel

In the event any of the Contractor or his Sub- Contractors, personnel, agents, sub-agents, assistants, or other employees shall be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties or it is undesirable for any administrative reasons for such person to be employed, the Contractor, if so directed, shall immediately remove such person or persons from employment thereon. Any person or persons so removed shall not again be employed in connection with this Contract without the written permission of the Purchaser. Any person so removed shall immediately be replaced by a qualified and competent substitute at the Contractor's cost and expenses. Should the Contractor be requested to repatriate any person he shall do so and shall bear all costs and charges in connection therewith.

10.32 Force Majeure

The following shall constitute Force Majeure:

1. Acts of God, acts of Government and other causes as strikes, lockout or other concerted action of workmen, war, sabotage, riots, civil commotion, police action, revolution, flood, fire, earthquake and epidemic. However power cut and Failure in water supply shall not be considered under Force Majeure conditions.

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2. If the Contractor suffers delay in the due execution of the contractual obligations due to delays caused by Force Majeure as defined above, the agreed time of completion of the work covered by this contract and of the obligations of the Contractor shall be extended by a period of force majeure, provided, that on the occurrence of any such contingency, the Contractor immediately reports to the Purchaser in writing, the cause of delay with requisite documentary evidence and also the remedial steps being taken and the expected period of interruption.

   - However, as regards to the Sub-Contractors of the contractor, the events or occurrences enumerated above in Clause 10.32.(1) which are site-specific to Neyveli shall constitute force majeure events but excluding strikes, Lockouts or other concerted action of workmen of such subjects.

3. The decision of the Purchaser whether there is a Force Majeure condition or not and whether extension of time shall be granted or not shall be final.
4. Force Majeure conditions prevailing at the works of the Sub-Supplier(s) / Sub-Contractor(s) other than the following four (4) major sub-suppliers shall not be recognised by the Purchaser on any account and it shall be up to the Contractor to make necessary alternative arrangement to execute the Contract within the agreed time schedule.
   i) ALSTOM Boiler Deutschland GmbH, Stuttgart, Germany
   ii) ALSTOM India Ltd., Durgapur Works, West Bengal, India
   iii) ALSTOM India Ltd., Shahabad Works, Maharashtra, India
   iv) Tata Refractories, India
5. The contractor or the Purchaser shall not be liable for delays in performing his obligations resulting from any Force Majeure cause as referred to and/or defined above. The date of completion shall subject to hereinafter provided, be extended by a reasonable time even though such cause may occur after the contractor's performance of his obligations has been delayed for other causes.
6. If the performance of the contract is substantially prevented, hindered or delayed for a continuous period of more than 180 (one hundred eighty) days on account of one or more events of force majeure during the currency of the contract, then the Purchaser and Contractor shall discuss and agree upon for taking appropriate decision on future course of action.

10.33 Jurisdiction, Resolution of Disputes & Arbitration

10.33.1 Jurisdiction

The laws applicable to this Contract shall be the laws in force in India. The civil courts having ordinary original jurisdiction over Neyveli shall alone have exclusive jurisdiction over all matters concerning this Contract including the arbitration proceedings if any arising under the Contract.

10.33.2 Resolution of Disputes

Informal Dispute Resolution

1. The parties agree to use reasonable efforts to resolve all disputes equitably and in good faith. If any dispute between the Contractor and the Purchaser

arises it shall in the first instance be referred in writing to the Purchaser, who shall endeavour to resolve the dispute amicably and render a decision within 30 days. The period of 30 days shall be reckoned from the date of intimation of the dispute is received by the Purchaser.

2. Save as hereinafter provided, in respect of a dispute so referred, the decision of the Purchaser shall be final and binding upon the Parties until the completion of the Contract and shall forthwith be given effect to by the Contractor who shall proceed with the Contract with all due diligence, whether or not either Party has sought arbitration of the dispute as hereinafter provided.

10.33.3 Arbitration

In the event of any dispute or difference, relating to the interpretation and application of the provisions of the Contracts, such dispute or difference shall be referred by either party to the arbitration of one of the Arbitrators in the Department of Public Enterprises. The Arbitration and Conciliation Act, 1996 shall not be applicable to the arbitration under this clause. The award of the Arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may make a further reference for setting aside or revision of the award to the Law Secretary, Department of Legal Affairs, Ministry of Law & Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary or the Special Secretary/Additional Secretary when so authorised by the Law Secretary, whose decision shall bind the parties finally and conclusively. The parties in the dispute shall share equally the cost of arbitration as intimated by the Arbitrator. The Procedure to be adopted in the case of arbitration is as per the Government's Circular dated 30.06.93 and its amendments, if any issued from time to time.

10.34 Warranty

1. The Contractor shall guarantee that the equipment shall be new and in accordance with the Contract documents and be free from defects in design, material and workmanship. The warranty period shall be 12 (twelve) months from the date of successful date of completion of Performance Guarantee Tests and acceptance of results by the Purchaser/Consultant for respective units. If the PG test is not performed within 12 months of provisional takeover, due to reasons not attributable to the Contractor, then warranty period shall start at the end of 12th month. In this case the PG test shall be conducted on a mutually agreed date. The Contractor's liabilities shall be limited to the replacement of any defective parts in the equipment of his own manufacture or those of his Sub-Contractors, under the normal use and arising from faulty design, materials and/or workmanship. The plant shall be operated as per the operating instructions and all records, log books and other information about the operation shall be kept. Such replaced defective parts shall be taken back by the Contractor. The Purchaser may however carry out maintenance as per O&M manual during the warrantee period as per accepted practices.
2. The Purchaser under the supervision of the Contractor's experts shall carry out complete operation of the plant after Provisional take over till completion of warranty period. However (i) All the maintenance works including repairs

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and / or replacement until acceptance of PG test results shall be carried out by the Contractor and (ii) All repairs and / or replacement other than maintenance works until the end of the warranty period shall also be carried out by the Contractor to fulfil the warranty obligation. Contractor shall provide minimum technical personnel as required to provide guidance to Purchaser's O & M personnel till the completion of warranty period for both units. The modalities of providing such technical personnel till completion of the Warranty Period shall be mutually discussed and agreed during the contract execution stage.

This, however, shall not dilute the Contractor's liability during the guarantee period.

3. In the event of any emergency where, in the judgment of the Purchaser or the Consultant, delay would cause serious loss or damage, repairs, replacements or adjustments may be made by the Purchaser or the Consultant or a third party chosen by the Purchaser or the Consultant with advance notice indicating the reasonable time required to the Contractor and the cost of such work shall be paid by the Contractor, or by the Surety. In the event of such action being taken by the Purchaser or the Consultant, the Contractor shall be notified promptly and he shall assist wherever possible in making the necessary corrections. This shall not dilute the Contractor's liability under the terms and conditions of the Contract.
4. If it becomes necessary for the Contractor to replace or renew any defective portions of the plant under this clause, the provisions of this clause shall apply to the portion of the plant so replaced or renewed until the expiry of 12 months from the date of such replacement or renewal. If any defects be not remedied within a reasonable time, the Purchaser or the Consultant may proceed to do the work at the Contractor's risk and costs, but without prejudice to any other rights which the Purchaser may have against the Contractor in respect of such defects.
5. The repaired or new parts shall be furnished and erected free of cost at site by the Contractor. If any repair is carried out on his behalf at the site, the Contractor shall bear the cost of such repair.
6. The cost of any special or general overhaul rendered necessary during the guarantee period due to defects in the plant or defective work carried out by the Contractor, shall be borne by the Contractor.
7. The acceptance of the equipment by the Purchaser or the Consultant shall not in any way relieve the Contractor of his obligations under this clause.
8. In case of these defective parts which are not repairable at site but are essential for the commercial use of the equipment, the Contractor and the Purchaser or the Consultant shall mutually agree to a programme of replacement or renewal which shall minimise interruption to the maximum extent, in the operation of the equipment.
9. At the end of the guarantee period, the Contractor's liability ceases except for latent defects.

"Latent Defect" means any repeated defect or repeated adjustment in the equipment / system which was not revealed in the normal standard inspection checklist of manufacture, erection and operation, but exhibits as

observation or as deviation in operation parameters or as repetitive failure of certain components after Warranty Period and when variations in operating conditions are experienced and ultimately could be solved only by replacement or repair / correction of equipment or parts of equipment."

For latent defects, the liability period shall be upto 3 (three) years after the expiry of the guarantee period. In respect of goods supplied by the Sub-Contractors to the Contractor where a longer guarantee (more than 12 months) is provided by such Sub-Contractors, the Purchaser shall be entitled to the benefit of such longer guarantee.

The equipment shall be operated as per the Contractor's O&M Manual.

10. The provisions contained in Clause 10.34(1) shall not be applicable:
    (a). If the Purchaser has not operated the equipment according to the generally approved industrial practices and in accordance with the conditions of operation specified and in accordance with operating manuals, if any.
    (b). In case of normal wear and tear of the parts.
11. All costs on account of these warranty obligations shall be to the account of the Contractor.
12. The Contractor should furnish an Indemnity Bond in the prescribed format as per Annexure-XVI for the equipment to be taken away from Project site for repair/rectification.
13. **Defect Liability for Civil Works: Intentionally deleted**

10.35 Tests on Completion

The final tests so as to demonstrate performance guarantees shall be carried out by the Contractor in the presence of Purchaser/Consultant within a reasonable period of time from the date on which the plant is provisionally taken over. Should the result of these test be not as specified, the tests shall be repeated by the Contractor within one month from the date of plant is made ready by the Contractor for retest and the Contractor shall pay to the Purchaser the expenses which the Purchaser may incur due to such retests.

10.36 Access To and Possession of Site

1. Subject to clause 10.36(3) of this clause, access to and possession of the Site shall be afforded to the Contractor by the Purchaser in reasonable time to start the Contract Work as per agreed time schedule as specified in the Contract. All temporary access roads at works site and other areas allotted to the contractors in connection with contract works shall be constructed and maintained by the Contractor.
2. In the execution of the work, no person other than the Contractor, Sub-Contractor and his or their employees shall be allowed on the Site except with the written permission of the Purchaser. Facilities to inspect the works at all times shall be afforded by the Contractor to the Purchaser and his representatives and other authorised officials.
3. The access to and possession of the Site referred to in sub-clause 10.36.1 shall not be exclusive to the Contractor but only such as shall enable him to execute the works. The Contractor shall afford to the Purchaser and to other

Contractors whose names shall have been previously communicated in writing to the Contractor by the Purchaser, reasonable facilities for the execution of the work concurrently with his own.

4. Unless otherwise provided in the Specification, the Purchaser shall allow the Contractor for carrying out the work at the Site continuously, without hindrance. While normally the Purchaser shall allow normal working hours, for completing the work within the time schedule, the Purchaser, if necessary shall also allow the Contractor for carrying out the work round-the-clock for which written approval shall be obtained by the Contractor from the Purchaser and subject to applicable labour laws in this regard.

10.37 Due Dates of Payment

Payment shall be due and payable by the Purchaser within a reasonable period which shall not normally exceed one month from the date of the receipt of each complete and correct invoice by him supported by requisite certificate issued by the purchaser/his authorised agency and proper documentation. If it is not payable the invoice shall be returned to the Contractor stating the reasons for rejection within 15 (fifteen) days from the date of receipt by the Purchaser.

10.38 Deductions from Contract Price

The Contractor shall reimburse the Purchaser all costs, charges, damage or expenses which the Purchaser may have paid or incurred, if and to the extent to which the Contractor is liable under this Contract to pay within 30 (thirty) days upon written request of the Purchaser, failing which such costs, charges, damages or expenses shall be deducted by the Purchaser from any money due or becoming due by him to the Contractor under this Contract or any other Contract failing which such amounts shall be considered as debt due from the Contractor to the Purchaser and shall be recoverable accordingly.

10.39 Construction of Contract

The schedules and terms and conditions herein contained including Annexures shall construe the entire contract and understanding between the parties and shall be binding on both the parties. All other communications which were made prior to the signature of the Contract between the parties hereto with respect to the subject matter hereof shall form the schedule of references and form part of the Contract.

10.40 Rights of Purchaser to Vary Scope

(1). The Purchaser shall have the right, during the performance of the Contract, to change the scope and/or technical character of the Project and/or of the supplies and services stipulated in the Contract.

(2). If any changes are required for completeness of the work as per Clause-10.7 the Contractor shall not be entitled to extra price or time.

(3). In the event, the Purchaser requests a change as per above Clause-10.40 (1) the Contract price and time shall be adjusted upwards or downwards, as the case may be and as shall be mutually agreed. The Contractor shall not be entitled to any extension of time unless such changes adversely affect the time schedule.

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(4). The Contractor shall not change any work to be made pursuant to this Contract except as may become necessary to enable him to meet his technical obligations under this Contract, provided however that such changes shall be subject to prior written approval of the Purchaser.

(5). If any changes are required for completeness of the works as per Clause 10.40(2), or the Contractor himself makes changes as per Clause 10.40 (4), the Contractor shall not be entitled to extra price or time.

(6). The Contractor shall proceed with the changes as requested as per Clause 10.40(1) pending adjustment of Contract price and time schedule where so applicable in terms of Clause-10.40(3).

(7). In the event that a request for changes by the Purchaser should affect the guarantees of the plant/process, a readjustment of such guarantees shall be agreed upon jointly, before the Contractor proceeds with the change.

(8). Changes occasioned due to non-observance by the Contractor of the provisions of this Contract or arising out of detection by the Purchaser of errors in the documents or in works not in compliance with the design, specifications & drawings or with the best engineering practice, shall neither give rise to price adjustment nor extension of time. The Contractor shall take immediate steps to restore the contractual position.

10.41 Waiver

1. Non-enforcement by either party of any of the provisions of this Contract shall not operate or constitute as a waiver of the provision itself or any subsequent breach thereof.
2. The validity of the Contract shall not be affected, should one or more of its stipulations be or become legally invalid and such stipulation is severable from and not fundamental to the obligations of either party to this Contract. In such a case, the parties shall negotiate in good faith to replace the invalid clause by an agreed stipulation which is in accordance with the applicable law and which shall be as close as possible to the parties original intent.

10.42 Assignment

1. The Contractor shall not assign its rights and obligations under the terms of this Contract to any party other than its legal successor without the written consent of the Purchaser.
2. Should loan/financial agreement(s) require the Contractor to assign, by way of charge, any money due or to become due to it, to a bank/credit agency for the benefit of receiving payment by the Contractor under this Contract from such bank/credit agency, or if any partial assignment is necessary to be made to any insurer in terms of Insurance Policy approved by the Purchaser, the Purchaser shall not refuse consent in such cases.

10.43 Contract Amendments

1. Any amendment to the terms of this Contract (including Schedules & Annexures) shall be made in writing by both parties hereto and shall specifically state that it is an amendment to the Contract.

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2. Contractor shall not suspend the performance of this Contract during review and negotiation of any amendment to the contract except as may be directed by the Purchaser.
3. No amendment shall have any effect until the Purchaser and Contractor have agreed to the amendment in writing.

10.44 Applicable Law

This Contract shall be governed by prevailing Indian Laws.

10.45 Notices

(1). All notices under this Contract shall be given in writing and shall be deemed sufficiently given when delivered either in person or by, telegram, telex, fax, e-mail or by registered mail addressed to the other party at its address set forth in the contract agreement with a copy to the nominated representative at site.

(2). If any such notice is delivered by hand, it shall be duly acknowledged and if given by telegram, telex, fax it shall be confirmed by Registered Letter within seven days of the date of such notice. Either party shall by notice in writing inform the other party of any change of its address as stated under Clause 10.45 (1) for receiving such notices.

(3). Date of notices under Clause-10.45 (1) shall be the date of receipt of such notice by the receiving party.

10.46 Language

1. All documents, instructions, catalogues, brochures, pamphlets, design data, norms and calculations, drawings, operation, maintenance and safety manuals, reports, labels, on deliveries and any other data shall be in the English Language
2. The Contract documents and all correspondence between the Purchaser/consultants and the Contractor shall be in the English language.
3. However, all signboards required to indicate "Danger" and/or security at site and other statutory signage shall be in English and Hindi and compulsorily in the local language of Tamil. Other Indian languages shall also be considered depending upon the workforce deployed at site.

10.47 Statutory and Other Regulations

1. The Contractor shall comply with all the statutory obligations of Government of India/State Government of Tamil Nadu applicable at site and the Purchaser shall not be liable for any action of the statutes applicable due to non-fulfillment of statutory obligations by the Contractor.
2. Explosives shall not be used at the site by the Contractor without the permission in writing of the Purchaser and then only in the manner and to the extent to which he has prescribed. Where explosives are used, the same shall be stored in a special magazine to be provided by and at the cost of the Contractor, who shall be liable for all damages loss or injury to any person or property and shall be responsible for complying with all statutory obligations in these respects.

3. The Contractor shall give all notices and pay all fees required to be given or paid under any Central or State statute, ordinance or other law or any regulation or by-law of any local or other duly constituted authority in relation to the execution of the Contract Work. The fees for obtaining statutory license in the name of Purchaser shall be paid by Purchaser.
4. The Contractor shall conform in all respects with the provisions of any statute, ordinance or laws as aforesaid and the rules, regulations or by-laws of any local or other duly constituted authority which may be applicable to the works or to any temporary works and with such rules and regulations of public bodies as aforesaid and shall keep the Purchaser indemnified against all penalties and liabilities of every kind for breach of any such statute, ordinance, law, rule, regulation or by-law.
5. All fossils, coins, articles of value of antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall as between the Purchaser and the Contractor be deemed to be the absolute property of the Purchaser and the Contractor shall take reasonable precaution to prevent its workmen or any other person from removing or damaging any such article or thing and shall immediately upon discovery thereof and before removal acquaint the Purchaser of such discovery and carry out at the expense of the Purchaser as to the disposal, removal or otherwise of the same.
6. Except where otherwise specified, the Contractor shall pay all tollage and other royalties, rent and other payments or compensation, if any, for getting stone, gravel, clay, or other materials required for the work or in connection therewith.
7. All operations necessary for the execution of the works and for the construction of any temporary works shall so far as compliance with the requirements of the Contract permits be carried on so as not to interfere unnecessarily or improperly with the public convenience or the access to use and occupation of public or private roads and footpaths or of properties whether in the possession of the Purchaser or any other person and the Contractor shall save harmless and indemnify the Purchaser in respect of all claims demands, proceedings, damages, costs, charges and expenses, whatsoever arising out of or in relation to any such matters.
8. The Contractor shall use every reasonable means to prevent any of the highways and bridges communicated with or on the routes to the site from being damaged or injured by any of his or any of his Sub-Contractor's traffic and in particular shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as shall inevitably arise for moving of plant and materials from and to the site shall be limited as far as reasonably possible so that no unnecessary damage or injury may be occasioned to such highways and bridges. For any damage caused by the breach hereof, the Contractor shall be solely responsible.
9. Where the nature of the work is such as to require the use by the Contractor of water borne transport, the foregoing provisions of this clause shall be construed as though "high sea" including a lock, dock, seawall or other structure related to waterway and "vehicles" including craft and shall effect accordingly.

10. On completion of the work, all rubbish, kilns, vats, tanks, materials and temporary structure of any sort or kind used for the purpose or connected with the construction/erection work are to be removed by the Contractor and all pits and excavations filled up and the site handed over in a tidy and workmanlike condition and no final payment in settlement of the account for the said work shall be held to be due or shall be made to the Contractor till such site clearance shall have been effected by him and such clearance may be made by the Purchaser at the expenses of the Contractor in the event of his failure to comply with this provision within 15 (fifteen) days after receiving notice in writing from the Purchaser to that effect. If it becomes necessary for the Purchaser to have the site cleared as indicated above at the expense of the Contractor, the Purchaser shall under no circumstances be held liable for any losses or damages to such of Contractor's property as may be on such site due to such removal there from, which removal may be effected by means of public sale of such materials and property or in such a way as seems fit and most convenient to the Purchaser.
11. The Contractor must take sufficient care in moving its construction plants and equipment from one place to another so that they may not cause any damage to the property of the Purchaser, particularly to the existing structures and overhead and underground services and in the event of Contractor's failure to do so, the cost of such damages shall be borne by the Contractor.

10.48 Labour

10.48.1 Labour rules

In respect of all labour directly or indirectly employed on the works by the Contractor, the Contractor shall comply with and implement all the provisions of the Contract Labour (Regulation and Abolition) Act 1970, or any amendment thereof, and all legislations and rules of the State and/or Central Government or other local authority formed from time to time governing the protection of health, sanitary arrangements, wages, welfare and safety of labour employed on the works and the Contractor shall be deemed to be the Principal employer for this purpose. The rules and other statutory obligations with regard to fair wages, welfare and safety measures, maintenance of register etc. shall be deemed to be part of the Contract. The Contractor shall get himself registered with the concerned statutory authorities as provided in the Act and shall be directly responsible to the authorities there under for compliance with the provisions thereof.

10.48.2 Provision of Minimum Wages Act and Payment of Wages

(i). The Contractor shall comply with the provisions of the Minimum Wages Act 1948. The minimum wages Central Rules 1950, the Payment of Wages Act 1936 or any other rules made there under by the Government of Tamil Nadu in respect of all employees employed by him or his Sub-Contractor directly or indirectly for the purpose of carrying out the works. In the event of retrenchment of workers by the Contractor or Sub-Contractors employed by the Contractor during or after the completion of the work, the retrenchment compensation and other benefits shall be paid by the Contractor to the workers as per the Industrial Dispute Act.

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(ii). If any money shall, as a result of any claim or application made under the said acts, be directed to be paid by the Purchaser, such money shall be deemed to be money payable to the Purchaser by the Contractor and/or failure by the Contractor to repay the Purchaser, any money paid by the Purchaser as aforesaid, latest within 30 days after the same shall have been demanded from the Contractor, the Purchaser shall be entitled to recover the same from any money due or accruing to the Contractor under this or any other contract with the Purchaser, failing which such amount shall be considered as debt due from the Contractor to the Purchaser.

(iii). The Contractor shall comply with the provisions of bi-partite and tripartite agreement entered into by the Purchaser from time to time with the Labour Unions and/or the circulars issued by the Purchaser regarding payment of minimum wages and benefits applicable.

10.48.3 Reporting of accidents to labour

The Contractor shall be responsible for the safety of his and his Sub-contractor(s)/Workmen and employees. All accidents at site are to be immediately reported to the required authorities. The Contractor shall be responsible for all such accidents.

10.48.4 Provision of Workmen's Compensation Act

The Contractor shall be liable for in respect of any damages or compensation payable by law in respect of or in consequence of any accident or injury to any workmen or other person in the employment of the Contractor or any of his Sub-Contractors and the Contractor shall save harmless and shall indemnify and keep indemnified the Purchaser against all such damages and compensation and against all claims, demands, proceedings, costs, charges and expenses, whatsoever, in respect thereof or in relation thereto. The Contractor shall at all times indemnify and keep indemnified the Purchaser against all claims for compensation under the provisions of the Workmen's Compensation Act 1948 or any other law for the time being in force by or in respect of any workmen employed by the Contractor or his Sub-Contractors / agencies in carrying out the Contract and against all costs and expenses of penalties incurred by the Purchaser in connection therewith. In every case in which by virtue of the provisions of Section-12, Sub-Section(I) of the Workmen's Compensation Act 1923, the Purchaser is obliged to pay compensation to a workmen employed by the Contractor or his Sub-Contractor/ agencies, the amount of compensation so paid and without prejudice to the rights of the Purchaser under Section-12, Sub-Section (2) of the said Act, the Purchaser shall be at liberty to recover such amount or any part thereof from the security deposit or from the sums due or to become due to the Contractor (whether under this Contract or any other Contract) .

10.48.5 Provisions of Apprentices Act

The Contractor shall comply with the provisions of the Apprentices Act 1961, and the rules and orders issued there under from time to time. If he fails to do so, his failure may be treated as breach of the Contract and the Purchaser may, in his discretion, terminate the Contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

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10.48.6 Labour Returns

The Contractor shall submit daily statements of labour employed by him/Sub-contractor(s) in the proforma prescribed by the Purchaser.

10.48.7 Labour Camps

The Contractor shall, at its own expense, make adequate arrangements for housing, electricity, road, supply of drinking water and provision of latrines and urinals for its staff and labour, disposal of sewerage and sullage and for temporary creche (bal mandir) where 50 or more women are employed at a time. Drinking water and power supply shall be provided at a single point near the colony by the Purchaser (Further distribution shall be by the Contractor). However, power consumption shall be charged at the appropriate rate.

10.48.8 Preservation of Peace

The Contractor shall take requisite precautions and use his best endeavour to prevent any riotous or unlawful behaviour by, or amongst its workmen and/or others employed on the works by him or his Sub-contractor(s) and for the preservation of peace and protection of the inhabitants and security of the property in the neighbourhood of the works/site. In the event of the Purchaser requiring the maintenance of a special police force at or in the vicinity of the site during the tenure of the Contract in consequence of the riotous or unlawful behaviour by, or amongst the Contractor's or his Sub-contractor(s)/Workmen and/or others staff employed by him/them, all expenses thereof and costs of all damages due to such riotous or unlawful behaviour shall be borne by the Contractor and if paid by the Purchaser, shall be recoverable from the Contractor from any money due or that may become due to the Contractor by the Purchaser.

10.48.9 Payment of Wages

(i). The Contractor shall make regular and prompt payment of wages to its workmen engaged in the work and in no case shall the payment be delayed more than seven days following the period for which the wages are due. The Contractor shall send a certificate to the Purchaser to this effect every month. If it is found that workers are not paid regularly, the Contract is liable to be terminated.

(ii). The Purchaser shall have the right to enquire into and decide against any complaint alleging that the wages paid by the Contractor to any labourer for the work done by such labourer is less than the wages paid for similar work in the neighbourhood.

(iii). As a number of Contractors may be working at the same time in the erection of different parts at the Project site, there is need for pursuance of a coordinated policy in regard to employment, wages and other conditions of work. The Contractor shall consult the Purchaser on all such matters to arrive at mutually agreed settlements.

10.48.10 Sanitary arrangements

The Contractor shall comply with all local sanitary rules in force and carry out all sanitary measures and permit inspection of all sanitary arrangements at all reasonable times by the Purchaser/local bodies.

10.48.11 Infectious diseases

The Contractor shall employ such persons as are found to be free of contagious diseases and shall produce, if required by the Purchaser, certificate of fitness of all its employees working at site. The Contractor shall, if required by the Purchaser, subject all its employees to regular medical check up and produce satisfactory evidence of their being free from any contagious disease.

10.48.12 The Contractor shall remove from its labour camp such labour and their families who refuse protective inoculations and vaccination when called upon to do so by any competent authority.

10.48.13 Medical Facilities at Site

The Contractor shall provide reasonable medical facilities at the site as per rules in force in relation to the strength of the Contractor's staff and workmen deployed at site.

10.48.14 Use of intoxicants

The use or sale of ardent spirits or other intoxicating beverages, within the works or in any of the buildings, boarding houses, encampments or other tenements owned, occupied by or within the control of the Contractor or any of its employees or his Sub-contractor is strictly forbidden and the Contractor shall ensure strict compliance.

10.48.15 Age limits of labour

The Contractor shall not employ, for the purpose of the work, any person below the age of 18 years as it is statutorily forbidden. The Purchaser reserves the right to dis-allow any labourer, whom he considers to be underage, to be employed by the Contractor. The Contractor shall submit periodical statements to the Purchaser, of labour employed by him.

10.48.16 Provident Fund

(i). The Contractor shall be solely responsible for deduction and contributions under the Employees' Provident Fund Act 1952 and Family Pension Act 1971 and the scheme made there under as amended from time to time. He shall be solely responsible for the maintenance of records for payment of contributions and submission of returns in accordance with the said act and scheme.

(ii). In case the Contractor fails to make payments under the above act and the scheme made there under and as amended from time to time, the Purchaser reserves the right to make such payment on behalf of the Contractor on demand from the authorities under the act and recover the same from the payments due to the Contractor. Further, the Contractor shall indemnify and keep indemnified the Purchaser against any loss or damage whatsoever that may be suffered by the Purchaser as a results of any claims, damages, penalties for any failure, non- compliance on his part with the provisions of the aforesaid act and the scheme framed there under.

10.48.17 Observance by Sub-Contractor(s)

The Contractor shall also be responsible for the observation of all the above clauses by his Sub contractor(s).

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10.49 Care of Works

From the commencement to the completion of work, the Contractor shall take full responsibility for the care of works and for all temporary works and in case any damage or loss shall happen to the works or to any part thereof or to any temporary works from any cause whatsoever, the Contractor shall at his own cost replace or repair and make good the same.

10.50 Restriction of Visitors

The Contractor shall not allow any visitors on the works except with the prior written approval of the Purchaser.

10.51 Possession Prior to Completion

The Purchaser shall have the right to take possession or use any completed or partially completed work. Such possession or use shall not be deemed to be an acceptance of any work done not in accordance with the Contract. However, any damage to such work solely due to such provision or use shall be to the Purchaser's account.

10.52 Work Permit, Passport, Etc.

The Contractor shall be responsible for arranging and obtaining at his own cost, the necessary work permits, passports, visas, police permits and expenses and for other effects of any personnel employed or engaged by him for work, which are non- residence of India.

10.53 General

No Director or Official or Employee of the Purchaser shall in any way be personally bound or liable for the acts or obligations of the purchaser under the contract or answerable for any default or omission in the observance or performance of any of the acts, matters or things or conditions which are herein contained.

10.54 General Liability Provision

The rights and obligations of the parties are finally and conclusively defined in this Contract.

10.54.1 Limitation of Liability

Except in case of Criminal Negligence or Wilful Misconduct,

1. The Contractor shall not be liable to the Purchaser, whether in Contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Purchaser, and,
2. The aggregate liability of the Contractor to the Purchaser, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to any obligation of the Contractor to indemnify the Purchaser with respect to Patent infringement.

10.55 Transfer of Titles

10.55.1 Imported Items

Title of ownership and Property to all imported equipment, materials (including imported components to be further processed in India), drawings & documents to be delivered by the contractor in terms of the contract shall pass to the Purchaser in accordance with the 'Incoterms 2010' and transfer of ownership and property to the Purchaser shall be simultaneous at the time of delivery to the carrier, provided however, such passing of title of ownership & property to the Purchaser shall not in any way absolved, or dilute of diminish the responsibility and obligations of the Contractor under this contract including loss or damages and all risks, which shall vest with the contractor till the successful commissioning as per this contract.

10.55.2 Self Manufactured Indigenous Items

Ownership of equipment supplied under the supply portion of the contract shall vest with Purchaser as soon as they are despatched ex-works/place of despatch, in respect of indigenous items. However for executing the erection portion of the contract, Contractor shall take over, all such equipment from purchaser and further shall take full responsibility for safe custody, transportation to site, handling at all intermediate points and at site, storage, erection, testing and commissioning of equipment and for their exclusive use for purposes specified in this contract. Contractor's liability under the contract shall not be over till the plant in successfully commissioned and taken over by purchaser. The despatch document consigned in the name of the Purchaser, shall be endorsed by the Purchaser, in favour of the Contractor for receipt of goods and then for storage, erection testing and commissioning. Purchaser's responsibility shall be limited to endorsement of despatch documents in Contractor's favour to enable the contractor to carryout services under the erection portion of the contract.

10.55.3 Bought out items

The procedure described in the above clause covers the self manufactured items of the Contractor. For bought out items directly consigned to purchaser's site, from approved sub-supplier, the consignee shall be the Purchaser. Sale in transit is acceptable to the Purchaser. However, no additional Sales tax liability shall arise to the Purchaser. The dispatches shall be made as performance relevant provisions of CST Act. However, the contractor shall ensure that no additional liability towards sales tax arises to the Purchaser.

10.56 Indemnity Bond

For the equipment handed over to Contractor, for performing the work under this contract, Contractor shall execute a custody cum indemnity bond in favour of Purchaser as per Annexure-XVI. The endorsement and handing over of despatch documents by purchaser to contractor shall be construed as having handed over and entrusted to the Contractor all the equipment covered in such despatch documents. The Contractor shall hold the equipment handed over to him by Purchaser, as trustee on behalf of the Purchaser without having any lien or charge against the equipment at any stage. For any loss or damage to the equipment and material till these are finally taken over by Purchaser, the contractor shall immediately replace/repair the loss or damaged equipment entirely at his cost

irrespective of the extent and/or time of realisation of claims by him from the insurer/underwriters.

The title of ownership and property to all goods materials equipment etc. originating in India shall pass to the purchaser as per the terms and conditions of this contract after the Contractor has effected the despatch of the same to Project Site and the Contractor has prepared necessary documentation for handing over the same to Purchaser's authorised representative provided however, such passing of titles of ownership and property to the Purchaser shall not in any way absolved, dilute or diminish the responsibility and obligations of the Contractor under this Contract including loss or damage and all risks which shall vest with the Contractor till the successful commissioning as per this Contract.

10.57 Safety

The Contractor shall abide by the Safety Code for Contractors which is annexed as Annexure-XVII.

10.58 General Conditions for Erection

The Contractor shall abide by the General Conditions for Erection, which is annexed as Annexure-XX.

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ANNEXURE – XX

GENERAL CONDITIONS FOR ERECTION WORKS AND CIVIL WORKS

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ANNEXURE - XX

GENERAL CONDITIONS FOR ERECTION AND CIVIL WORKS

GENERAL CONDITIONS FOR ERECTION WORKS

1.0 GENERAL

1.1 The following shall supplement the conditions already contained in the other parts of the specifications and documents and shall govern that portion of the work of the Contract to be performed/undertaken at the project site.

1.2 The Contactor upon signing of the Contract shall, in addition to a Project Coordinator, nominate another responsible officer as its representative at site suitably designated for the purposes of overall responsibility and co-ordination of the Works to be performed at site. Such person shall function from the site office of the Contractor during the execution of Contract. This representative shall have full technical capability and complete administrative and financial powers to expeditiously and efficiently execute the work under the Contract.

1.3 The Contractor shall proceed with the work to be performed under the Contract and each and every part and detail thereof, in the best and most workman like manner by engaging qualified, diligent and efficient workers, and undertake the several parts thereof, at such time and in such order as agreed in the contract , and finish such work in strict conformity with the plans, drawings and/or specifications, and any changes, modifications or amplifications thereof made by the Purchaser/Consultant.

1.4 The Contractor shall not sell, assign, mortgage hypothecate or remove equipment or materials or materials which have been installed or which may be necessary for the completion of the Contract, without the written consent of the Purchaser.

2.0 REGULATIONS OF LOCAL AUTHORITIES AND STATUES

2.1 The Contractor shall ensure compliance with all statutes, laws, rules and regulations of the Central or State Government or any other authority such as the Workmen's Compensation Act 1923, Payment of Wages Act, Minimum Wages Act 1948, Employees State Insurance Act, Employees Provident Fund Act, etc. and any and all statutory modifications thereof in connection with employees engaged by him or his Sub-Contractors in performance of the work.

2.2 The Contractor shall conform to the provisions of Indian Boiler Regulation, State government Factory Laws, Indian Electricity Act and rules made there under, and any other acts of legislature relating to the work and to the regulations and bye-laws of any national or local authority and of any water, lighting and other companies and/or authorities with whose systems the plant/structure is proposed to be connected and shall before making any variations from the drawings or specifications that may be necessitated by so conforming, giving to the Purchaser/Consultant written notice, specifying the variations proposed to be made and the reason for making it any apply for instructions thereof.

2.3 The Contractor shall arrange to give all notices required by the said Acts, Regulations or Bye-laws to be given to any Authority or to any Public Officer and pay all fees that may be properly chargeable in respect of the works and lodge the receipts with the Purchaser/Consultant, unless otherwise, specified in the specification. Obtaining all permits and licenses required there upon is the responsibility of the Contractor.

2.4 All registration and statutory inspection fees, in respect of the work pursuant to the Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant and equipment ultimately to be owned by the Purchaser shall be to the account of the Purchaser. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or its Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.

3.0 CONTRACTOR'S HEALTH AND SAFETY PROGRAM

Refer Contract specification and also Annexure-XVII of this Volume for safety code.

4.0 PURCHASER'S LIEN ON EQUIPMENT

The Purchaser shall have lien on all equipment including those of the Contractor brought to the site for the purpose of erection, testing and commissioning of the plant. The Purchaser shall continue to hold the lien on all such equipment throughout the period of Contract. No material brought to the site shall be removed from the site by the Contractor and/or its Sub-Contractor's without the prior written approval of the Purchaser/Consultant.

5.0 INSPECTION, TESTING AND INSPECTION CERTIFICATES

5.1 The provisions of the clause entitled Inspection, Testing and Inspection Certificates shall also be applicable to the erection portion of the works. The Purchaser / Consultant shall have the right to re-inspect any equipment (though previously inspected and approved by him, at the Contractor's works) before and after the same are erected at Site. Inspection will be carried out as per the mutually agreed QAP for shop manufactured items. After receipt of the materials / equipments at site, in case of doubt, the Purchaser may ask for re-inspection after mutual discussion and agreement with the contractor as per the approved QAP for the materials / equipments to perform as per the contract within the contract price. If by the above inspection, the Purchaser / Consultant rejects any equipment, the Contractor shall make good for such rejections either by replacement or modifications / repairs as may be necessary, to the satisfaction of the Purchaser / Consultant. Such replacements will also include the replacements or re-execution of such of those works of other Contractor's and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

5.2 Any work, which proves faulty, shall be corrected by the Contractor without undue delay. The fact that the Purchaser / Consultant or their representatives have not pointed out faulty work or that which is not in accordance with plans and specifications, shall not relieve the Contractor from correcting such work as directed by the Purchaser / Consultant, without additional compensation.

5.2.1 In the event finished/completed work is 'dismantled' for the purpose of re-inspection due to damage (arising due to transportation and storage at site), in case of doubt, the Purchaser may ask for re-inspection after mutual discussion and agreement with the contractor as per the approved QAP for the materials / equipments to perform as per the contract within the contract price.

5.3 The Purchaser / Consultant, their representatives and employees shall, at all reasonable times, have free access to the works and/or to the workshops, factories or other places where materials are being prepared or constructed in performance of the Contract and also to any place where the materials are lying or from where they are being obtained, and the Contractor shall give every facility to the Purchaser / Consultant and his representatives for

inspection and examination and test of the materials and workmanship even to the extent of discontinuing portions of the work temporarily, or of uncovering or taking down portions of finished work after mutual agreement.

6.0 ACCESS TO SITE AND WORKS ON SITE

6.1 Suitable access and possession of the site shall be provided to the Contractor by the Purchaser in reasonable time.

6.2 The Purchaser shall make ready the necessary foundations to be provided by it ready, as per the agreed schedule, for the execution of the individual phases of works.

6.3 In the execution of the works, no persons other than the Contractor or its duly appointed representative, Sub-Contractor and workmen shall be allowed to undertake work on the site, except by the special permission, in writing of the Purchaser / Consultant or its representative.

6.4 Access to the site at all times shall be accorded to the Purchaser / Consultant and other authorized officials and statutory Public Authorities. Nevertheless, the Contractor shall not object to the execution of the work by other Contractors or tradesmen whose names shall have been previously communicated in writing to the Contractor by the Purchaser / Consultant and afford them to coordinate for the execution of their several functions simultaneously with his own.

7.0 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

7.1 The Contractor shall establish a Site Office at the site and keep posted an authorized representative for the purposes of the Contract. Any written order or instruction of the Purchaser / Consultant or his duly authorized representative, shall be communicated to the authorized representative for the purposes of the Purchaser / Consultant or his duly authorized Contractor at the Site Office and the same shall be deemed to have been communicated to the Contractor at his legal address.

7.2 The Contractor shall employ at least one competent representative whose name or names shall have previously been communicated in writing to Purchaser/Consultant by the Contractor, to supervise the erection of the plant and to carry out the work. The said representative or if more than one shall be employed, then one of such representatives shall be present at the site during working hours, and any written orders or instructions which the Purchaser/Consultant may give to the said representatives of the Contractor

shall be deemed to have been given to the Contractor. It is essential that the supervisory personnel shall be capable of speaking and writing in English language and preferably conversant with the local language –Tamil.

8.0 CO-OPERATION WITH OTHER CONTRACTORS

8.1 The Contractor shall cooperate with all other Contractors or tradesmen of the Purchaser, who may be performing other works on behalf of the Purchaser and the workmen who may be employed by the Purchaser and doing work in the vicinity of the works under the Contract. Purchaser will be the single point of co-ordination for the same. The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other Contractors and its workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Purchaser due to the Contractor's work shall promptly be made good at its own cost. The Purchaser/Consultant shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the Workmen of the Purchaser in regard to their work.

8.2 The Purchaser/Consultant shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's works. The Purchaser/Consultant shall determine the corrective measures, if any, required to rectify this situation after inspection of the works and such decisions by the Purchaser/Consultant shall be binding on the Contractor. If a part of the Contractor's work depends, for proper execution, upon the work of any other Contractor, the Contractor shall inspect and promptly report in writing to the Purchaser/Consultant any defect in such work of other Contractors that render it unsuitable for proper execution of the work under the Contract. Failure to so inspect and report shall constitute an acceptance of 'Others' work as fit and proper for the reception of his work, except as to defects which may develop in the work of 'Others' after the proper execution of the work. To ensure proper execution of his sub-sequent work, the contractor shall inspect work already in place and shall at once report to the Purchaser/Consultant any discrepancy between the executed work and the drawings.

9.0 DISCIPLINE OF WORKMEN

9.1 The Contractor shall adhere to the disciplinary procedure set by the Purchaser/Consultant in respect of its employees and workmen at site. The

Purchaser/Consultant shall be at liberty to object to the presence of any representative or employee of the Contractor at the site, if in the opinion of the Purchaser/Consultant such employee has misconduct himself or be incompetent or negligent or otherwise undesirable and then the Contractor shall remove such a person object to and provide in his place a competent replacement at his own expense.

10.0 CONTRACTOR'S FIELD OPERATION

10.1 The Contractor shall keep the Purchaser/Consultant informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Purchaser/Consultant shall not relieve the Contractor of any of his responsibility towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Purchaser/Consultant or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

10.2 The Contractor shall have the complete responsibility for the conditions of the work site including the safety of all persons employed by him or its Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of his 'Contract' and shall not be limited to normal working hours. The construction review by the Purchaser/Consultant is not intended to include review of Contractor's safety measures in, on or near the work-site, and their adequacy or otherwise.

10.3 The work so far as it is carried out on the Purchaser's premises/the project site, shall be carried out at such time as the Purchaser may approve consistent with the construction schedule and so as not to interfere unnecessarily with the conduct of the Purchaser's business and the Purchaser will give the Contractor all reasonable facilities for carrying out the work.

11.0 PHOTOGRAPHS AND PROGRESS REPORT

Refer relevant clause of Schedule-10 of this Volume.

12.0 MANPOWER REPORT

12.1 The Contractor shall submit to Purchaser/Consultant on the first day of every

month, a Manpower Report for the upcoming/next month, detailing the manpower scheduled/proposed/planned to be deployed for the month, skill-wise and area-wise.

12.2 The Contractor shall also submit to the Purchaser/Consultant on the first day of every month, a manpower report of the previous month detailing the number of persons planned to have been deployed to that and actually deployed, skill-wise and the areas of employment of such labour.

13.0 PROTECTION OF WORK

13.1 The Contractor shall have total responsibility for protecting his works till it is finally accepted by the Purchaser/Consultant. No claim will be entertained by the Purchaser/Consultant for any damage or loss to the Contractor's works and the Contractor shall be responsible for the complete restoration of the damaged works to its original condition to comply with the specifications and drawings. Should any such damage to the Contractor's works occur because of another party not under his supervision or control, the Contractor shall make and take-up its claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's 'works' the same shall be resolved as per the provisions of above Clause-8 titled 'Cooperation with other Contractors'. The Contractor shall not cause any delay in the repair of such damaged 'Works' because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such dispute.

13.2 The Contractor and his Sub-Contractors shall take necessary care to see that no damage to the work which has been completed by others is caused by its own men during the course of execution of their work. The Contractor or its-sub-contractor are not responsible for protection of others work. However, Contractor shall ensure that no damage is caused by its own men during the course of execution of their work.

13.3 All other work completed or in progress as well as machinery and equipment that are liable to be damaged by the Contractor's work shall be protected by the Contractor and such protection shall remain and be maintained until its removal is directed by the Purchaser.

13.4 The Contractor shall effectively protect all the works from action of weather and from damages or defacement and shall cover finished parts where

required for their thorough protection. Face work shall be perfectly clean and free from defects.

13.5 The work shall be carried out onto completion without damage to any work and property adjacent to the area of his work, to whomsoever it may belong, without interference with the operation of their existing machines or equipment.

13.6 The Contractor shall provide the necessary temporary roadways, footways, guards as may be rendered necessary by reason of his work, for the protection and accommodation of foot passengers of other traffic of the Purchaser or occupier of adjacent property and of public. The Contractor shall at the times provide sufficient temporary barriers, notice boards and lights to protect and warn the public and post necessary watchman to guard the site and equipment. He shall take all precautions necessary and shall be responsible for the safety of the work to be performed by him. The Contractor shall also observe and display Safety First signs and shall have proper safety and fire protection equipment.

13.7 Adequate lighting at and near all the storage, handling, fabrication, pre-assembly and erection sites for properly carrying out the work and for safety and security shall be provided by the Contractor. The Contractor's work area shall be adequately lighted during night time too. The Contractor should also engage adequate electricians/wiremen, helpers, etc., to carry out and maintain these lighting facilities. If the Contractor fails to provide all the above listed facilities, the Purchaser may provide such facilities as it may deem necessary and charge the cost thereof to the Contractor. In any case the Contractor shall be liable for any damages and consequences arising out of its neglect in this regard.

14.0 EMPLOYMENT OF LABOUR

14.1 The Contractor/Sub-Contractors will be expected to employ on the work skilled employees with experience of his particular work. No person below the age of eighteen years shall be employed.

14.2 The Contractor shall furnish details of the qualifications and experience of his senior supervisors and Consultants assigned to the work, including their experience in supervising erection and commissioning of plant and equipment of comparable capacity.

14.3 All travelling expenses including provisions of all necessary transport to and from site, loading allowances and other payments to the Contractor's

employees shall be the sole responsibility of the Contractor.

14.4 The hours of work on the site shall be decided by the Purchaser and the Contractor shall adhere to it. Working hours for each employee will normally be 8 (eight) hours per day.

14.5 The Contractor's employees shall wear suitable identification badges while on work at site clearly indicating his name, designation, Employer etc, among other essential details.

14.6 The Contractor shall ensure that it pays its personnel/workmen regular wages, overtime and other compensations. The attendance register and the wage register shall be submitted to the Purchaser for verification at regular intervals. The Contractor shall also furnish the Purchaser at fortnightly intervals a certificate that he has paid all the dues to his workmen. In case such payment is not made regularly by the Contractor, the Purchaser will be in his right to make such payments and deduct the same from the Contractor's progress payments.

14.7 In case the Purchaser becomes liable to pay any wages or dues to the labour or to any Government agency under any of the provisions of the Minimum Wages Act, Workmen's Compensation Act or any other law due to act of omission of the Contractor, the Purchaser may make such payments and shall recover the same from the Contractor's bills.

14.8 None of the Contractor's superintendents, supervisors, Consultants or labour may be withdrawn from the work without due notice being given to the Purchaser/Consultant. Further, no such withdrawal shall be made if, in the opinion of the Purchaser/Consultant, it will jeopardize the required pace of progress and/or the successful completion of the work.

14.9 In connection with the performance of work under this Contract, the Contractor shall not discriminate on the basis of race, religion, colour or national origin. It is also expected that the Contractor in his selection of personnel will give due regard to their ability to co-operate with the Purchaser/Consultant. Suggestions and recommendations made by the Purchaser/Consultant relating to the work and coordination thereof are to be carefully and courteously considered.

15.0 FACILITIES TO BE PROVIDED BY THE PURCHASER

15.1 Space

Refer Schedule-2 of this Volume.

15.2 **Electricity**

Refer Schedule-2 of this Volume.

15.3 **Water**

Refer Schedule-2 of this Volume.

15.4 **Construction Tools and Equipment**

Refer Schedule-2 of this Volume.

16.0 FACILITIES TO BE PROVIDED BY THE CONTRACTOR

16.1 **Tools, Tackles and Scaffoldings**

16.1.1 The Contractor shall provide at its own cost & expense, all the construction equipment, false work, erection tools, machine tools, power tools, tackles, hoists, cranes, derricks, cables, slings, skids, scaffolding work benches, tools for rigging, cribbing and blocking, welding machines preheating and stress relieving equipment, X-ray and all associated protective equipment, instruments, appliances, materials, and supplies required for unloading, transporting, storing, erection, testing and commissioning that may be required to accomplish the work under the Contract unless otherwise specifically provided for. Adequacy of such tools will be subject to final determination of the Purchaser/Consultant. He shall submit a list of all such materials to the Purchaser / Consultant before the commencement of pre-assembly at site. These tools and tackles shall not be removed from the site without the written permission of the Purchaser/ Consultant.

16.1.2 The Contractor shall also furnish all necessary expandable devices like anchors, grinding and abrasive wheels, raw plugs, hacksaw blades, taps, dies, drills, reamers, chisels, files, carborandum stones, oil stones, wire brushes, necessary scaffolding, ladders, wooden planks, timbers, sleepers and consumable material like welding electrodes, oxygen, acetylene, argon, lubricating oils, greases, cleaning fluids, cylinder oil, graphite powder and flakes, fasteners, gaskets, temporary supports, stainless steel shims of various thickness as required, cotton waste, cheese cloth and all other miscellaneous supplies of every kind required for carrying out the work under the 'Contract'.

16.1.3 The Contractor shall provide all reasonable facilities including tools, personnel, etc. and ensure coordination with the Purchaser / Consultant and the SUB-Contractor's erection supervisors to enable them to carry out all supervision, measurements, checks, etc. in a satisfactory manner.

16.1.4 The Contractor shall not dispose of, transport or withdraw any tools, tackles, equipment and material provided by him for the 'Contract' without taking prior written approval from the Purchaser/Consultant, and the Purchaser/Consultant at all times shall have right to refuse permission for disposal, transport or withdrawal of tools, tackles, equipment and material if, in his opinion, the same will adversely affect the efficient and expeditious completion of the 'Project'.

16.2 **Communication**

The Contractor will make its own arrangement for all his communication needs such as telephone, email etc. at its Site Office. The Purchaser will assist or facilitate the Contractor in obtaining the above facilities, if requested.

16.3 **First-Aid**

The Contractor shall provide necessary first-aid facilities for all its employees, representatives and workmen at the site.

16.4 **Cleanliness**

16.4.1 The Contractor shall be responsible for proper house-keeping the entire area allotted to him, clean and free from rubbish, debris etc. during the period of 'Contract'. The Contractor shall employ sufficient number of special personnel to thoroughly clean his work area at least once in a day. All rubbish and scrap material shall be identified, stacked or disposed in a place to be identified by the Purchaser / Consultant. Materials and stores shall be so arranged to permit easy cleaning and upkeep. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil-proof sheet shall be provided to protect the floor from such damage.

16.4.2 Similarly, the offices of the Contractor shall be kept clean and neat to the satisfaction of the Purchaser/Consultant. Proper sanitary arrangements shall be provided by the Contractor in the work areas and offices of the Contractor.

17.0 LINES AND GRADES

17.1 All the works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the works. Basic horizontal and vertical control points will be established and marked by the Purchaser / Consultant at site at suitable points. These points shall be used as datum for the 'Works' under the Contract. The Contractor

shall inform the Purchaser / Consultant well in advance of the times and places at which he wishes to do work in the area allotted to him, so that suitable datum points may be established and checked by the Purchaser / Consultant to enable the Contractor to proceed with its works. Any work done without being properly located may be removed and/or dismantled by the purchaser/Consultant at Contractor's expense.

17.2 Where the Purchaser/Consultant had already established the base lines and bench marks adjacent to the various sections of work, the same must be carefully preserved by the contractor, and in case of their unnecessary destruction by him or any of his employees, these will be re-established by the Purchaser/Consultant at the Contractor's expense.

17.3 The Contractor shall be responsible for the accuracy of all dimensions within the various sections of the work according to the figures of dimensions in the drawings.

18.0 FIRE PROTECTION – NOT APPLICABLE

19.0 SECURITY

Refer Schedule-2 of this Volume.

20.0 CONTRACTOR'S AREA LIMITS

The Purchaser/Consultant will clearly demarcate the boundary limits of access roads, parking, spaces, storage and construction areas and the Contractor shall not tress-pass areas not so marked out for him. The Contractor shall be responsible to ensure that none of its personnel move out of the areas marked out for its operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him, the same shall be done only with the written permission of the Purchaser/Consultant.

21.0 CONTRACTOR'S COOPERATION WITH THE PURCHASER

21.1 In cases where the performance of the erection work by the Contractor affects the operation of the system facilities of the Purchaser/Consultant such erection work of the Contractor shall be planned to be performed only in the manner stipulated by the Purchaser/Consultant and the same shall be acceptable at all times to the Purchaser/Consultant. The Purchaser/Consultant may impose such restrictions on the facilities provided to the Contractor such as electricity, water etc. as he may think fit in the interest of the Purchaser and the Contractor shall strictly adhere to such restrictions and co-operate with the Purchaser/Consultant. It will be the responsibility of the Contractor

to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems, which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these documents.

This clause comes into effect only in the case of interferences between the Contractor and Purchaser's other Contractors. In such a case, the Purchaser / Consultant will discuss with all the parties concerned to reach consensus in the overall interest of the Project.

21.2 The Contractor at all times shall work in coordination with the Purchaser's Consultants and offer them all reasonable facilities to become familiar with the erection, operation and maintenance of the equipment.

21.3 In respect of observations of local rules, administrative orders, working hours and the like, the Contractor and his personnel shall cooperate with the Purchaser.

22.0 COMMISSIONING

The 'Commissioning' of the equipment supplied and erected by the Contractor shall be the responsibility of the Contractor as detailed in Tender specification. The Contractor shall provide in addition, test instruments, calibrating devices etc. and the labour required for the successful performance of these tests. If it is anticipated that the above tests may prolong for a long time, the Contractor's workmen required for the above tests shall always be present at site during such tests.

23.0 MATERIAL HANDLING AND STORAGE

23.1 All the equipment furnished under the Contract and arriving at site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.

23.2 The Contractor shall be responsible for examining all the shipment and notify the Purchaser/Consultant immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's / Consultant's information only. The Contractor shall submit to the Purchaser / Consultant every week a report detailing all the receipts during the week. However, the Contractor shall be

solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at the site (Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor).

23.3 The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Purchaser/Consultant at any time.

23.4 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings etc shall be used for unloading and/or handling of the equipment without the specific written permission of the Purchaser/Consultant. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage for such equipment at site.

23.5 All electrical panels, control gears, motors and such other devices, shall be properly dried by heating before they are installed and energized. 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 condition shall be periodically rotated to prevent corrosion due to prolonged storage and shall also be periodically inspected.

23.6 All 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 Purchaser/Consultant.

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

23.8 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

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

23.10 If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Purchaser/Consultant will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.

23.11 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally all the electrical equipment, such as motors, control gears, generators, exciters and consumables like welding electrodes, lubricants, etc. shall be stored in the closed storage space. The Purchaser/Consultant in addition, may direct the Contractor to move certain other materials which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.

23.12 The Contractor shall arrange for periodic inspection of material/equipment in his custody until taken over by the Purchaser and shall carry out all protective and preservative measures required thereupon.

23.13 The Contractor shall also keep a check on the deliveries of the equipment/material covered in his scope of erection and shall advise the Purchaser well in advance regarding possible hold-ups in his work due to expected delays in delivery of equipment, to enable the Purchaser to expedite the deliveries if Supplier is different from the Contractor.

23.14 All materials of Contractors should be received only during normal working hours. Damage of any of the roads due to movement of heavy trucks, trailers, crane and other equipment of the Contractor shall be made good by the Contractor. Otherwise same shall be got rectified by the Purchaser at the risk and cost of the Contractor.

23.15 All C&I electronic equipment shall be stored in Air-conditioned storage facility under the specified temperature and humidity conditions.

24.0 CONSTRUCTION MANAGEMENT

24.1 The field activities of the Contractors working at site, will be coordinated by the Purchaser/Consultant and the Purchaser/ Consultant's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors of the Purchaser regarding scheduling and co-ordination of work..

24.2 The Purchaser/Consultant shall hold weekly meetings of all the Contractor's working at site, at time and a place to be decided by the Purchaser/Consultant. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Purchaser /

Consultant and shall strictly adhere to those decisions in performing his 'Works'. In addition to the above weekly meetings, the Purchaser / Consultant may call for other meetings either with individual Contractors or with selected number of Contractors and in such a case the Contractor, if called, will also attend such meetings.

24.3 Time is the essence of the 'Contract' and the Contractor shall be responsible for performance of its works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Purchaser / Consultant satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

24.4 The Purchaser / Consultant shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

25.0 FIELD OFFICE RECORDS

25.1 The Contractor shall maintain at its site Office up-to-date copies of all drawings, specifications and other Contract Documents and any other supplementary data, complete with all the latest revisions thereto. The Contractor shall use only 'Approved-For Construction' drawings on the field, showing the approval stamp & category (Approval by Purchaser/Consultant). The Contractor shall also maintain, in addition, the continuous record of all changes, approval (by Purchaser/Consultant) status to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Consultant data to indicate as-built conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering, data shall be submitted to the Purchaser / Consultant in required number of copies. A record of all readings taken during the alignment of the equipment shall be maintained by the Contractor. This shall be signed by the erection supervisor and the Purchaser/Consultant as a token of their acceptance of the same. All such records shall be handed over to the Purchaser on completion of the works.

26.0 CONTRACTOR'S MATERIAL BROUGHT TO SITE

26.1 The Contractor shall bring to site all equipment, components, parts, materials including construction equipment, tools and tackles for the purpose of the works under intimation to the Purchaser/Consultant. All such goods shall, from the time of their being brought vest in Purchaser, but may be used for the purpose of the works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Purchaser/Consultant. But the Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

26.2 The Purchaser shall have a lien on such goods belonging to the Contractor for any sum or sums, which may at any time, be due or owing to him by the Contractor, under, in respect of or by reasons of the 'Contract'. After giving a 30 (thirty) days notice in writing of his intention to do so, the Purchaser shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

26.3 After the completion of the works, the Contractor shall remove from the site under the direction of the Purchaser/Consultant the materials such as construction equipment, erection tools and tackles, scaffolding, etc. with the written permission of the Purchaser / Consultant. If the Contractor fails to remove such materials, within 30 (thirty) days of issue of a notice by the Purchaser/Consultant to do so, then the Purchaser/Consultant shall have the liberty to dispose of such materials as detailed under Clause 16.4 above and credit the proceeds to the account of the Contractor.

26.4 On completion of the work, all rubbish, kilns, vats, tanks materials and temporary structures of any sort or kind used for the purpose or connected with the construction/erection work are to be removed by the Contractor and all pits and excavations filled up and the site handed over in a tidy and workmanlike condition and no final payment or settlement of the account for the said work shall held or due shall be made to the Contractor till such site clearance shall have been effected by him and such clearance shall be made by the Purchaser at the expense of the Contractor in the event of his failure to comply with this provision within 7 (seven) days after receiving notice in writing from the Purchaser to that effect. If it becomes necessary for the Purchaser to have the site cleared as indicated above at the expense of the Contractor, the Purchaser shall under no circumstances be held liable for any

losses of damages to such of Contractors property as may be on such site due to such removal there from, which removal may be effected by means of public sale of such materials and property in such a way as deemed fit and convenient to the Purchaser.

26.5 The Contractor must take sufficient care in moving his construction/erection plant and equipment from one place to another so that they may not cause any damage to the property of the Purchaser, particularly of the existing structures and overhead and underground services and in the event of the Contractors failure to do so, the cost of such damages shall be borne by the Contractor.

27.0 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

27.1 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Purchaser and the Purchaser/Consultant and the employees of other Contractors and Sub-Contractors and all public and private property including structures, buildings, other plants and equipment and utilities either above or below the ground.

27.2 The Contractor will ensure provision of necessary safety equipment such as barriers, signboards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Purchaser/Consultant and the Owner of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his 'Works' and shall make all necessary arrangements with such owners, related to removal and/or replacement or protection of such property and utilities.

28.0 PAINTING

All exposed metal parts of the equipment including pipings, structures, railings, etc. after installation, unless otherwise surface protected, shall be first painted with at least one coat of suitable primer which matches the shop primer paint used, after thoroughly cleaning al such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or shot blasting, and the same being inspected and approved by the Purchaser for painting. Afterwards, the above parts shall be finished with two coats of machinery enamel paints. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the Purchaser/Consultant.

29.0 INSURANCE

Refer Clause - Insurance under Schedule - 10 of this Volume.

30.0 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects, during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such works and with the concurrence of the Purchaser/Consultant. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the 'Works' as per the schedule.

31.0 PROTECTION OF MONUMENTS AND REFERENCE POINTS

31.1 The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of 'Works' either during excavation or elsewhere are properly protected and handed over to the Purchaser/Consultant.

31.2 Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked out either with the help of Purchaser/Consultant or by the Purchaser/Consultant shall not be disturbed in any way during the performance of his 'Works'. If any work is to be performed which may disturb such references, the same shall be done only after these are transferred to other suitable locations under the direction of the Purchaser/Consultant. The Contractor shall provide all necessary materials and assistance for such relocation of reference points, etc.

32.0 WORK & SAFETY REGULATIONS

Refer Technical Specification and also Annexure-XVII of this Volume.

33.0 ELECTRICAL SAFETY REGULATIONS

Refer Technical Specification and also Annexure-XVII of this Volume.

34.0 FOREIGN PERSONNEL

Refer Schedule-7 of this Volume.

35.0 PURCHASER'S INSTRUCTIONS

The Purchaser/Consultant may, in his absolute discretion, from time to time, issue further drawings and/or written instructions, details, directions and explanations, which are collectively referred to as "Purchaser's Instructions", in regard to :

1. Any additional drawings and explanations to exhibit or illustrate details.
2. The variation or modification of the design, quality or quantity of work or the additions or omission or substitution of any work.
3. Any discrepancy in the drawings or between the Schedule of Quantities and/or specification.
4. The removal from the site of any materials brought thereon by the Contractor and the substitution of other materials thereof.
5. The removal and/or re-execution of any work executed by the Contractor.
6. The dismissal from the work of any persons employed thereupon.
7. The opening up for inspection of any work covered up.
8. The amending and making good of any defects.
9. The Contractor shall comply with and duly execute any work covered in such 'Purchaser's Instructions' provided always that verbal instructions, directions, and explanations given to the Contractor or his foreman upon the work by the Purchaser/Consultant shall, if involving a variation, be confirmed in writing by the Purchaser/Consultant within 7 (seven) days.
10. If compliance with the 'Purchaser's Instructions as aforesaid involves work and scope beyond that contemplated by the 'Contract', unless the same were issued owing to some breach of this 'Contract' by the Contractor, the Purchaser shall pay to the Contractor the price of the said work as hereinafter provided.
11. If the Contractor after receipt of written notice from the Purchaser/Consultant requiring compliance, with such further drawings and/or 'Purchaser's Instructions' fails to comply with the same within 15 (fifteen) days the Purchaser may employ and pay other agencies to execute any such work whatsoever, as may be necessary to give effect thereto, and all costs incurred in connections therewith shall be

recoverable from the Contractor by the Purchaser on a certificate by the Consultant as a debt or may be deducted by the Purchaser from any money that may become due to the Contractor.

36.0 RIGHTS OF THE PURCHASER/CONSULTANT

36.1 Right to Illustrate and Explain Plans

36.1.1 The various parts of the 'Contract' are intended to be complementary to each other but should any discrepancy appear or any misunderstanding arise as to the import of anything contained therein, the explanation of the Purchaser/Consultant shall be final and binding.

36.1.2 The correction of any errors or omissions of the Drawings and Specifications may be made by the Purchaser / Consultant, when such correction is necessary to bring out clearly the intention which is indicated by the reasonable interpretation of the Drawings and Specifications as a whole.

36.1.3 Whenever in the Specifications or on the Drawings which are a part of the 'Contract' or which may be furnished to the Contractor for directing this work, the terms and descriptions of various qualities of workmanship, material, structures, processes, plant or other features of the 'Contract' are described in general terms, the meaning or fulfillment of which must depend upon individual judgement, then in all such cases the question of fulfillment of such specifications or requirements shall be decided by the Purchaser / Consultant and said material shall be furnished, said work shall be done, and said structure, process, plant or feature shall be constructed, furnished or carried on in full and complete accordance with his interpretation of the same and to his full satisfaction and approval, provided such interpretation is not in direct conflict with the Drawings and Specifications and generally accepted good engineering practice.

36.1.4 Details shown either on the Drawings or in the Specifications shall be done and furnished as if shown in both except where expressly except either in the Specifications or on the Drawings. Figured dimensions shall in all cases be taken in preference to scale measurements and detailed drawings consistent with general drawings shall be taken in preference to the general drawings of the same part of the work.

36.1.5 The Purchaser / Consultant may, from time to time, prepare for his own use estimates of quantities or bills of materials required for the work. Copies of such estimates or bills of materials which may be given to the Contractor for his convenience, or any lists, weights or quantities of materials or structures

which may appear on the drawings may not be considered as finally correct, sufficiently complete or accurately covering any portion or all of the work to be done under the 'Contract'. Such bills or estimates may be carefully assembled and prepared but their accuracy is not guaranteed. They may not be accurate as to any particular details and are given only as the best information available at the time of issue of the information. It is understood that any such lists or estimates are furnished to the Contractor for his convenience only and not as lists or estimates of work to be done, and many necessary items of work might have been omitted.

36.1.6 Additional drawings and explanations to exhibit or illustrate details may be provided by the Purchaser / Consultant whenever necessary and if so provided, and if consistent with the Drawings and Specifications, it shall be binding upon the Contractor to take cognizance of the same. The written decision of the Purchaser / Consultant as to the true construction and meaning of the Drawings and Specifications and of such additional drawings and explanations shall be binding upon the Contractor.

36.2 **Right to Direct Work**

36.2.1 The Purchaser / Consultant shall have the right to direct the manner in which all work under this Contract shall be conducted, in so far as it may be necessary to secure the safe and proper progress and the specified quality of the work, and all work shall be done and all material shall be furnished to the satisfaction and approval of the Purchaser / Consultant.

36.2.2 Whenever, in the opinion of the Purchaser / Consultant, the Contractor has made marked departures from the schedule of completion laid down in the Contract or when untoward circumstances force a departure from the said schedule, the Purchaser / Consultant, in order to assure the compliance with the schedule and the provisions of the 'Contract', shall direct the order, pace and method of conducting the work, which shall be adhered to by the Contractor.

36.2.3 If, in the judgement of the Purchaser / Consultant, it becomes necessary at any time to accelerate the overall plant erection work, the Contractor, when ordered and directed by the Purchaser / Consultant, shall cease work at any particular point and transfer his men to such other point or points, and execute such portion of his work, as may be required, to enable others to hasten and properly engage and carry on their work, all as directed by the Purchaser / Consultant.

36.2.4 Night work will be permitted only with prior approval of the Purchaser / Consultant. The Purchaser / Consultant may also direct the Contractor to operate extra shifts over and above normal day shift for the completion of 'Contract' on schedule if, in his opinion, such work is required.

36.3 **Right to Order Modifications of Methods and Equipment**

36.3.1 If at any time the Contractor's methods, materials or equipment appear to the Purchaser / Consultant to be unsafe, inefficient or inadequate for securing the safety of the workmen or the public, the quality of work or the rate of progress required, he may order the Contractor to ensure their safety and increase their efficiency and adequacy, and the Contractor shall promptly comply with such orders. If at any time, the Contractor's working force and equipment are in the opinion of the Purchaser / Consultant, inadequate for securing the necessary progress, as herein stipulated, the Contractor shall, if so directed, increase the working force and equipment to such an extent as to give reasonable assurance of compliance with the schedule of completion. The absence of such demands from the Purchaser / Consultant shall not relieve the Contractor of his obligations to secure the quality, the safe conducting of the work, and the rate of progress required by the Contract, and the Contractor alone shall be and remain liable and responsible for the safety, efficiency and adequacy of his methods, materials, working force and equipment, irrespective of whether or not he makes any change as a result of any order or orders received from the Purchaser / Consultant.

36.4 **Right to Perform**

36.4.1 The Purchaser reserves the right to perform or have performed in and about the works during the time when the Contractor is performing his work hereunder, such other work as the Purchaser desires, and the Contractor shall make all reasonable effort to perform his work hereunder in such a manner as will enable such other work to be performed without hindrance and shall make no claim for damage against the Purchaser arising out of such other work to be performed against hindrance and shall make no claim for damage against the Purchaser arising out of such other work or interference there from. The Contractor shall work in harmony with such other Contractor's regardless of race, religion, colour or national origin and any dispute between Contractors shall be arbitrated by the Purchaser / Consultant.

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37.0 MEASUREMENT OF WORK AND PROGRESS PAYMENTS

37.1 The Purchaser / Consultant may, from time to time, intimate the Contractor that he requires the works to be measured and the Contractor shall attend or send a qualified agent to assist the Purchaser / Consultant or its representative in taking such measurements and calculations and to furnish all particulars as may be required.

37.2 Where the erection of equipment, vessels and structural steel is involved, the basis of such measurements and progress evaluation shall be weights specified in the shipping documents or invoices or drawings as decided by the Purchaser / Consultant. Should the Contractor not attend or neglect or omit to send such agents, then the measurement taken by the Purchaser / Consultant or approved by him shall be taken to be the correct measurements of the work. The Contractor or its Agent may, at the time of measurement, take such notes of measurements as it may deem fit.

37.3 When measurements are effected by conditions already established, the Contractor shall take field measurements notwithstanding scale or dimensions shown on the drawings.

37.4 The measurements so taken and certified correct by the Purchaser / Consultant shall be the basis for the progress payment to the Contractor. Where the break-up of 'Contract on unit basis Price' is difficult to arrive at, the Purchaser / Consultant and the Contractor shall work out at the commencement of the 'Contract', the weightages or the cost or the cost break-ups to arrive at a mutually agreeable basis for computation of the progress estimates.

37.5 To the value so arrived at on the basis of the Contractor's monthly progress evaluated, shall be added the amounts earned by the Contractor under supplemental Contracts and orders if any, till date of the progress estimate. From the total thus computed, all previous payments plus any amounts due to the Purchaser in accordance with the terms of this Contract shall be deducted. The remainder shall be paid by the Purchaser to the Contractor under Interim Certificates from the Consultant.

37.6 In case work is nearly suspended or in case only unimportant progress is being made, or in case it is apparent that Contractor is about to forfeit his 'Contract' or that the money yet due to him shall not complete his 'Contract', the Purchaser may at his discretion withhold any payment which may be due to the Contractor.

37.7 The Purchaser may withhold part or whole of any payment for erection claimed by the Contractor, which in opinion of the Purchaser, is necessary to protect himself from loss on account of :

(a) Defective work not remedied or guarantees not met.

(b) Claims filed against the Contractor.

(c) Failure of the Contractor to make due payment for materials supplied or labour employed by him.

(d) Damage to other Contractor's Purchaser's or Other's property.

(e) Failure to meet the mutually agreed schedules.

(f) When the grounds for withholding payments are removed, payments of the amount due to the Contractor shall be made by the Purchaser within a reasonable period.

(g) The Contractor shall not demand nor be entitled to receive payment for the work of portion thereof, except in the manner set forth in this 'Contract' and only after the Purchaser / Consultant shall have given a certificate for such payment.

38.0 ADHERENCE TO MANUFACTURER'S INSTRUCTION

Adherence to instructions of the Manufacturer's supervisory Consultants, is compulsory. The Contractor shall work under the guidance of the Manufacturer's supervisors to ensure that erection procedures adopted by the Contractor as well as completed erection of equipment is such as not to interfere with or prevent equipment from functioning as intended, as well as to the entire satisfaction of the Manufacturer's supervisor / Purchaser / Consultant. The Contractor shall also permit and provide all facilities for the Manufacturer's erection supervisors to carry out all checks that they may wish to, and approve any erection procedure and/or final setting and alignment of components, in order to satisfy themselves that erection has not been carried out as intended by them. This shall, however, in no way relieve the Contractor of his responsibility for providing adequate and competent supervision and quality workmanship.

39.0 MODIFICATIONS

The Contractor shall carry out all modifications at site as directed by the Purchaser / Consultant to complete the work covered in the Contract. It is the responsibility of the Contractor to get the prior approval for such modifications from the Purchaser / Consultant before such works are taken

up. The Contractor shall also get the estimates and the actual time sheets certified by the Purchaser/Consultant, and these certified time sheets will be the basis for processing his bills for such modification works which are required to be carried out for no fault of the Contractor.

40.0 DEFECTIVE WORK

If the work or any portion thereof shall be damaged in any way excepting by the acts of the Purchaser or if defects not readily detected by prior inspection shall develop before the final completion and acceptance of the whole work, the Contractor shall forthwith make good, without compensation, such damage or defects in a manner satisfactorily to the Purchaser / Consultant. In no case shall defective or imperfect work be retained.

41.0 WORK OF OTHERS

If any part of the Contractor's work depends, for proper execution, upon the work of any other Contractor, the Contractor shall inspect and promptly report in writing to the Purchaser / Consultant any defect in such work of other Contractors that render it unsuitable for proper execution of the work under the Contract. His failure to so inspect and report shall constitute an acceptance of the other Contractor's work as fit and proper for the reception of his work, except as to defects which may develop in the work of other Contractors after the proper execution of the work. To ensure proper execution of his subsequent work, the Contractor shall inspect work already in place and shall at once report to the Purchaser / Consultant any discrepancy between the executed work and the drawings.

This clause comes into effect only in the case of interferences between the Contractor and Purchaser's other Contractors. In such a case the Purchaser / Consultant will discuss with all the parties concerned to reach a consensus in the overall interest of the Project.

GENERAL CONDITIONS FOR CIVIL WORKS

Intentionally deleted.

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ANNEXURE – XVII

SAFETY CODE FOR CONTRACTOR

1.0 GENERAL

1.1 Safety is the responsibility of every employee, individually and collectively.

1.2 Head of the Dept/Division should ensure that a copy of this Contractor's Safety Code is handed over to every Contractor working under his control and he should in turn prominently display all rules on the office/site notice board for the benefit of all the men working under him.

1.3 The Contractor shall in connection with provide adequate guards, illumination, fencing and watch wherever necessary at the construction site & working area, for the safety & convenience of general public.

1.4 Fire extinguishers adequate in number and with proper validity shall always be kept by the Contractor at the site of works, where there is risk of fire hazard, especially near the site stores.

1.5 Adequate washing facilities with proper drainage shall be provided and properly maintained near the place of work but at a safe distance from railway tracks and busy roads.

1.6 Whenever work is to be undertaken near a place, where there is a risk of drowning, arrangements to be made for safe barricading of such areas. All necessary equipment shall be provided and kept ready for use and necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first-aid treatment of all injuries likely to be sustained during the course of the work, in case of a mishap.

1.7 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be open to inspection by the Safety Engineer, the Labour Officer, Engineer-in-charge of the concerned Department or their representatives.

1.8 Notwithstanding the above clauses, there is nothing in these to exempt the Contractor from the operation of any other Act or Rule in the Republic of India for the safety of men and materials.

1.9 An injury sustained in the plant, must be immediately reported to the First-Aid Station or next higher Supervisor/Officer in-charge, no matter how minor the nature of the injury.

1.10 In case of a fatal accident, the Contractor must inform the Engineer in-charge of the department for which he is working and a report in writing should be made, clearly explaining the sequence of events leading to the accident.

1.11 Smoking or use of naked lights is strictly prohibited near gas lines, valves and any other equipment linked to the gas distribution networks.

1.12 Smoking and carrying of matches, lighters and other spark producing devices is strictly prohibited within the area where inflammable liquids are stored, handled or used or where loading or unloading operations are performed. Any tank or container containing inflammable liquid should be properly grounded for preventing ignition due to static electricity charges. Contractor should ear-mark such areas and provide necessary signage and warning signals.

1.13 Contractors should ensure that employees do not report to work while under the influence of intoxicants. Any employee found on duty under the influence of liquor or of intoxicating drugs, will be liable to severe disciplinary action.

1.14 Work surroundings should be kept clean, free from oil, grease and other obstructions or fallen objects like nuts bolts etc.

1.15 After a job or work is completed, all left-over junk and other scrap materials should be cleared from the area immediately.

1.16 Drums or other make-shift arrangement must not be used in place of ladders or as work benches or supports for any job.

1.17 Employees shall not walk through or cross any operating units unless their duties require them to do so, or they are authorised.

1.18 Compressed air should not be used for removing dust from one's clothes and deliberately directed or used on any person as it is likely to cause serious injury.

1.19 If an employee, in the course of his work, encounters conditions of unusual hazard with which he is not familiar, he should contact the supervisor for advice before proceeding further. He should also inform the Contractor as well as the Engineer in-charge.

1.20 Contractors should particularly ensure that they or their employees do not meddle with any equipment they are not concerned or unfamiliar with and see that they should generally keep away from such equipment.

1.21 It should be ensured that no one takes rest/shelter below any under cut pit/excavation or near any stock-pile of materials.

1.22 For any work involving repair & maintenance underground, the Contractor shall follow the safety procedural orders/instruction issued by the Purchaser.

1.23 The Contractor shall ensure supervision of such jobs by competent persons within the meaning of Factories Act & Rules.

1.24 All persons engage on such jobs shall have to have before hand proper training instructions as required under Factories Act & Rules.

2.0 SAFETY MEASURES IN CONTRACT WORK

Whereas, it is necessary to take steps to ensure safety at work sites by the executing contractual agency, it is incumbent of the Purchaser to introduce all measures to guide, induce, train and bind the agencies concerned to adopt remedial steps to prevent accidents. Problem gets aggravated in contractual zones due to lack of training, in-adequate supply of personal protective equipment, shortage of skilled labour changing deployment of works etc. Accordingly, the following measures are intended to be introduced and the salient clauses will be included in the contract documents.

2.1 The Contractor shall take all safety precautions and provide adequate supervision in order to carryout the job safely and without damage to men & equipment.

2.2 Any special safety precautions, if required to be followed by the Contractor, such clauses shall be added.

2.3 The executing department would take necessary shut-downs wherever there are hazards of gases, electricity, moving machinery etc. The Contractor shall ensure that the shut-down/clearance are taken before deploying workers to such locations.

2.4 The Contractor shall supply safety appliance such as safety shoes, safety belts, helmets, gloves, harness etc. to his workers depending on working conditions and life saving jackets shall always be kept in readiness at the site. The Contractor shall not deploy any workmen without safety shoes and safety helmet and the safety applicable to the specific work conditions.

2.5 Before starting the day's job, the Purchaser's Supervisor/representatives will ensure that safety briefing has been done to the Contractor's supervisor who has previously been imparted safety induction training.

2.6 Head / Zonal in-charge will nominate Engineer in-charge of the contractual work under reference who will be fully responsible for the safe execution of the work at site.

2.7 In case of injury to persons, the Contractors shall first take the injured person to nearest hospital with the necessary forms. In no case the Contractors are allowed to take injured persons directly to their own Doctors.

2.8 The Contractor shall abide by the provisions of Factories Act, State Factory Rules, Workmen's Compensation Act, Payment of Wages Act, Contract Labour (Regulation) Act etc. and keep the Purchaser indemnified of provision the above Acts and Rules.

2.9 The Head of Deptt. executing the contract upon the satisfaction that the Contractor is not conforming to the Safety requirements may direct stoppage of work and require the Contractor to remedy the defects. The Contractor shall not proceed with the work until he has complied with each directions to the satisfaction of such Head of the Department.

2.10 The Contractor shall be fully responsible for accidents caused due to him or his agents or workmen's negligence or carelessness in regard to the observance of the safety requirements and shall be liable to pay compensation for injuries.

2.11 Without prejudice to the right conferred by the above clause, for stoppage of work for violations of safety requirements the Contractor shall be liable for penalty as deemed fit for violation of safety rules & regulations upto first two instances. For the third violation he shall be liable to be debarred from further contracts upto a period of one year from the date of issue of debarring notice.

2.12 The Head of the Safety Engg. Deptt. or the Head of the Deptt. executing the contract will assess the penalty amount having regard to the circumstances, in particular, the nature and gravity of the violation. After issuing a notice to the Contractor to show cause why the amount specified therein shall not be imposed as a penalty and considering the cause shown by the Contractors, if any, he shall pass final orders which shall then be final and binding on the Contractor. The penalty amount will be recoverable from any bill and/or EMD/SD of the Contractor without any further reference to him.

2.13 Whenever work, at heights is involved, Contractor must obtain necessary permissions and clearances from the Safety Engg. Dept. for such persons required to do work at height.

2.14 Contractor must insure all the workmen under the "Workmen Compensation Act."

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SCHEDULE-9

PERFORMANCE GUARANTEES

9.1 General

1. The contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in the Contract specifications.
2. The contractor shall demonstrate and establish performance guarantee for various equipment and achieve performance guarantee values as per Contract Specification, at site in the presence of the Purchaser/Consultant for each unit individually.
3. Details of performance guarantee tests and method of computation of performance values shall be as per Contract Specification.
4. The Contractor shall supervise and direct the operation during performance tests and shall take complete responsibility in this regard.
5. During performance tests, the Purchaser shall make available necessary normal operating & maintenance personnel.
6. The Contractor shall provide and install all measuring instruments required for checking the guaranteed performance which are not included among the permanent measuring instruments of the system/sub-system. Such instruments shall be furnished by the Contractor on a temporary basis for the duration of the performance guarantee tests.

9.2 Performance Guarantee Values, Categories, Demonstration of Performance/Acceptance Tests and Liquidated Damages for Shortfall in performance / Non-Performance

1. Performance and ratings of the various offered equipment, as covered in this specification, shall be guaranteed by the Contractor.
2. The guaranteed performance parameters furnished by the contractor in its offer, shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties (permitted as per agreed test codes) and other uncertainties shall be deemed to have been included in the guaranteed figures.
3. The Contractor, during performance guarantee / acceptance test, shall demonstrate all the guarantees as covered in this Schedule. Bid price quoted by the Contractor shall include all costs associated with the tests.
4. Ambient conditions for guaranteed efficiency of steam generator shall be as follows:

(a)	Ambient Air Temperature	:	27°C
(b)	Relative Humidity	:	71%
(c)	Design Fuel / Lignite	:	As per Vol-IIA Specifications

5. Contractor shall quote the steam generator efficiency (by heat loss method) as per the requirement of BS EN 12952-15, 2003 (reaffirmed, latest). The

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guaranteed efficiency quoted by the Contractor shall comply with following limiting parameters with lignite firing.

(a)	Excess air at economizer outlet (at TMCR load)	:	$\geq$17%. If (i) quoted / (ii) actual value during the PG tests is higher than 17% the higher value will be taken.
(b)	Corrected flue gas temperature at RAPH outlet (at TMCR Load)	:	150°C or as predicted by the Contractor, whichever is higher
(c)	Loss due to un-burnt carbon in bottom ash at 100% TMCR)	:	1.5% (minimum) or quoted/actual value during the PG tests whichever is higher.

Note! No credit shall be given to the Contractor, in the evaluation of the results of the guarantee tests for performance predictions / guarantee etc. if the values considered by the contractor for parameters indicated above are lower (or better) than those specified above.

6. The performance guarantee tests shall be conducted by the Contractor for each unit individually and liquidated damages for non-performance as indicated under this schedule will be levied separately for each unit.

9.3 Performance Guarantee / Acceptance Test

1. The final test (performance guarantee / acceptance test) shall be conducted at site by the Contractor in presence of the Purchaser / Consultant. Such test will be completed, within a period of 3 (three) months after the successful completion of Trial Operation.
2. Instrumentation used, their accuracy class, their numbers & location etc. for carrying out performance guarantee / acceptance / demonstration tests shall be as per relevant codes and shall be subject to Purchaser's approval. In addition the values of parameters shall also be logged from the information system provided under Purchaser's DDCMIS (under Purchaser's scope) Tests will be conducted at specified load points.
3. Any special equipment, tools and tackles required for the successful completion of the performance guarantee / acceptance / demonstration tests shall be provided by the contractor at its cost.
4. If equipment / system fail to meet the guarantees, all necessary modifications and / or replacements shall be carried out by the successful Contractor(contractor) without any extra cost to the Purchaser so that the equipment / system comply with the guaranteed requirements. However, if even after above modifications / replacements, the contractor is not able to demonstrate the guarantees within 90 days or within a reasonable period allowed by the Purchaser (reckoned from the date on which the tests have been completed) the Purchaser will have the right to the following:
   (a). To reject the equipment / system / plant and recover the payment already made

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OR

to accept the equipment / system / plant after levying Liquidated Damages (LD) as specified in this Schedule (These are termed as "**Category – I**" Guarantees)

(b). To reject the equipment / system / plant and recover the payment already made. (These are termed as "**Category – II**" Guarantees and conformance to the performance requirement is mandatory. Category - II Guarantees do not attract LD)

(c). To reject the equipment / system / plant and recover the payment already made

OR

Accept the equipment / system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Purchaser. (These are termed as "**Category – III**" Guarantees and do not attract LD)

9.4 Schedule of Guarantees

(Unless specifically mentioned otherwise, the fuel to be considered for the following guarantees shall be design lignite fuel indicated in Vol-IIA of Contract Specification.

9.4.1 Category-I, Guarantees: Performance Guarantees Attracting Liquidated Damages

S.No	Description	Parameter for Performance Guarantee	Liquidated Damages
1.	Steam Generator Efficiency (%)	For shortfall in guaranteed efficiency percentage of SG while firing design lignite at rated steam parameters & rated excess air and other stipulated conditions at **100%** TMCR	**Rs. 5,69,40,000/-** (Indian Rupees Five Crores, Sixty Nine Lakhs and Forty Thousand only) for every 0.1% short fall in the efficiency or part thereof from guaranteed value at 100 % TMCR load
2.	Steam Generator Capacity TPH)	For shortfall in steam generating capacity in tonnes per hour of steam at rated steam parameters at superheater outlet (with any combination of mills working as per Purchaser's choice) while firing design lignite at 100% BMCR.	**Rs. 3,77,40,000/-** (Indian Rupees Three Crores, Seventy Seven Lakhs, Forty Thousand only) for every one (1) tonne per hour or part there of short fall in the steam output from the TPH specified / guaranteed
3.	Auxiliary Power Consumption (kW)	For increase in auxiliary power consumption in kW of all continuously operating power consuming auxiliaries of steam generator at 100% TMCR load. (Refer Clause 9.5)	**Rs. 1,99,000/** (Indian Rupees One Lakh, Ninety Nine Thousand only) for every 1 kW increase in auxiliary power consumption or part there of from the guaranteed value.

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9.4.2 Category-II, Guarantees (conformance to Guarantees is mandatory)

S.No	Description	Parameter	Requirement
(a)	NOx Emission Limit	Contractor shall guarantee that max. NOx emission from the unit will not be more than 260 grams of NOx per gigajoule of heat input (from thermal as well as fuel) to the boiler during the entire operating range of steam generator for the range of lignite specified in Vol-IIA of Contract Specification.	Mandatory requirement to be compulsorily met.
(b)	Dust concentration / Emission (Maximum) at ESP outlet	Contractor shall guarantee Dust concentration (Maximum) at ESP outlet with any one field out of service at 100% TMCR for the (worst lignite specified) at 27°C ambient and a minimum flue gas temperature of 150°C (corrected) shall not exceed 50 mg/Nm3	Mandatory requirement to be compulsorily met.

Emission shall be measured during steam generating capacity test. Contractor, in his offer shall furnish the methodology of measurement and demonstration of variations with respect to load upto 60% of the total load.

9.4.3 Category – III, Guarantees (Demonstration parameters, which do not attract LD)

(a). **No fuel oil support required above 40% BMCR**

Design of steam generator shall be such as not to call for oil support for flame stabilization beyond 40% of rated load when firing the lignite from the range specified in Vol-IIA of Contract Specification. Contractor shall guarantee and demonstrate that with any combination of mills (as per Purchaser's choice) in service, the steam generator does not require any oil firing for stable and efficient boiler operation at all loads above 40% BMCR. (Refer Vol. IIA of Contract Specification)

(b). **Furnace Exit Gas Temperature**

Maximum Furnace Exit Gas Temperature shall be guaranteed and demonstrated by the successful Contractor after commissioning of units with mill combinations as per Purchaser's choice and all other requirement of heat release rates as specified. (Refer Volume IIA of the Contract Specification)

(c). **Steam Temperature at Superheater (SH) and Reheater(RH) Outlet**

The Contractor shall guarantee and demonstrate that steam temperature at the outlet of superheater and reheater shall be as follows:

S.No	Description	Value
(i)	Steam temperature at superheater outlet (at Main Steam Stop Valve) at 100% TMCR while firing design lignite specified in Vol-IIA of Contract Specification.	540 ± 5°C
(ii)	Steam temperature at Reheater outlet at 100% TMCR while firing design lignite specified in Vol-IIA of Contract Specification.	568 ± 5°C

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(d). **SH / RH Attemperation System**

The Contractor shall guarantee and demonstrate that spray water flow for SH attemperation system does not exceed 8% of the main steam flow, while firing design lignite and while maintaining the rated SH outlet steam temperature at 100% TMCR.

The Contractor shall guarantee and demonstrate that spray water flow for RH attemporation system does not exceed 0.6% of the RH steam flow while firing design lignite and while maintaining the rated Reheater outlet temperature at 100% TMCR.

(e). **Noise Level**

The Contractor shall demonstrate that the noise level of all the equipments are not higher than the respective stipulated values indicated in Volume IIA of the Contract specification during the entire operating range of the steam generator for the whole range of lignite fuel in Vol-IIA of Contract Specification and under the operating conditions including the guaranteed output and efficiency points.

Sound pressure shall be measured all around the equipment at a distance of 1(one) m, horizontally from the nearest surface of any equipment/machine and at a height of 1.5 m above the floor level in elevation.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirements of IEC 651 or BS: 5969 or IS:9779.

(f). **Mill Capacity at Rated Fineness**

Performance testing shall be done on each mill toward establishing its capacity specified at the rated fineness, applying corrections for the variation in lignite fuel characteristics i.e. HGI and moisture.
Contractor shall guarantee capacity output of each mill at rated fineness and shall demonstrate the same with following conditions:

S.No	Description	Value
(i)	Lignite Fuel finess	• 40% pass through 0.09 mm mesh screen • 80% pass through 0.3 mm mesh screen
(ii)	Mill Loading	Max permissible mill loading for selection of mill capacity shall not exceed 85% of maximum load.
(iii)	Lignite quality	Design Lignite

Should the HGI and total moisture content of lignite vary from that given in the lignite fuel characteristics during demonstration test, corrections shall be applied to the measured capacity of mill based on the correction curves. These correction curves shall be furnished along with the Bid and shall be subject to Purchaser's acceptance.

9.4.4 Auxiliary Boiler

(i). Rated steam flow.
(ii). Rated steam temperature and pressure.

9.4.5 Compressed Air System

The following performance criteria for the compressed air system shall be guaranteed and demonstrated by the Contractor.

(i). Capacity of compressor in Nm^3/min at rated discharge pressure of 8.5 $kg/m^2(g)$.
(ii). Quality of instrument air (dew point) coming out of the air dryer.
(iii). Discharge air pressure at outlet of each compressor, kg/cm^2 (g)
(iv). Discharge air temperature at outlet of each compressor, °C.

9.5 Auxiliaries to be Considered for Auxiliary Power Consumption Guarantee

(a) Mills
(b) FD fans
(c) ID fans
(d) RAPHs
(e) Electrostatic Precipitator (Corona Power)
(f) Boiler water circulating pumps
(g) Seal air Fans
(h) Lignite Feeders
(i) ABGs
(j) Submerged Scrapper Chain Conveyor
(k) Bottom ash overflow recycling system equipments

9.6 Performance Test of Steam Generator

The performance tests shall be conducted (heat loss method) in accordance with the latest version of BS EN – 12952 – 15:2003 (by heat loss method) except for the specific requirements brought out herein below.

1. In order to correct the tested efficiency to the design condition, correction to the tested efficiency shall be applicable for variation in following parameters only:
   (a) Feed water temperature at economiser inlet.
   (b) Ambient air temperature
   (c) Relative humidity of ambient air
   (d) Hydrogen in lignite fuel
   (e) Moisture in lignite
   (f) Gross calorific value of lignite
   (g) Percentage of ash in lignite

   The Contractor, during detailed engineering, shall furnish correction curves to the Purchaser / Consultant, covering the expected ranges of variations for all these parameters for the range of lignite specified. Correction curves shall normally be within ± 5% only and shall be mutually discussed and agreed.

2. For all other aspects, not mentioned above, or in the specifications where BS code stipulates agreement between the parties concerned before the test, the Contractor shall obtain such approval from the Purchaser/Consultant.

3. The number, location, type and accuracy of the test grade thermocouples and pressure gauges shall be to Purchaser's approval.

4. The steam generator efficiency testing shall be carried out with any combination of mills in operation.

5. Performance tests shall also be conducted to prove the steam generating capacity of the steam generator at rated parameters and auxiliary power consumption of all continuously working steam generator auxiliaries (as listed in Clause 9.5 above) at stipulated loads.

6. Necessary write ups, schemes, instruments, schedules, detailed procedures clearly indicating period of tests, frequency of observations, etc. shall be prepared and submitted for all the tests for Purchaser's/Consultant's review and shall be got specifically approved from the Purchaser/Consultant at least one year before the tests are carried out.

9.7 Liquidated Damages for Non Performance

1. Should the results of the formal test show that the Steam Generator has failed to meet its guarantee, the Contractor shall carry out the modification at its own cost, if considered necessary, to meet the guaranteed values. In such a case the performance and guarantee tests shall be repeated by the Contractor within one (1) month from the date the equipment is ready for retest. If the specified guarantees are not established within 90 days of notification by the Purchaser, the Purchaser may at his discretion reject the equipment and recover the payments already made or accept the equipment after assessing the liquidated damages payable at the rates specified in Cl 9.4.1 of this Schedule for each steam generator. The recovery of such amount shall be from the amounts due to the Contractor. These liquidated damages shall be prorated for fractional parts of the deficiencies.

2. Specific performance guarantees which attract liquidated damages are detailed in Cl.9.4.1 of this schedule.

3. Other performance parameters as detailed in Clause 9.4.2 and 9.4.3 of this schedule, which do not attract liquidated damages, will be termed as demonstration parameters. Demonstration parameters / capabilities shall be demonstrated during the trial operation period/guarantee tests of the respective system/equipment as per the detailed test procedure to be approved by the Purchaser/Consultant.

4. The Guaranteed values by the Contractor for the Performance Guarantee Parameters for this Package (unit wise) are herewith attached.

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SCHEDULE OF PERFORMANCE GUARANTEE PARAMETERS

FOR UNIT-I

Section – A: Performance Guarantees under Liquidated Damages [L.D]

S. No	Particulars	Unit	Value inclusive of design, manufacture and all other Tolerances including measurement uncertainty
(i)	Steam Generator efficiency while firing design lignite at rated steam parameters and rated excess air and other stipulated conditions at 100%TMCR i.e. 500 MW unit load	%	89.79 According to EN12952-15 (LHV basis, with 1.5% loss due to unburnt carbon)
(ii)	Steam Generator output at 100 % BMCR at rated steam parameters at superheater outlet (with any combination of mills working as per Purchaser's choice) while firing design lignite.	TPH	1600
(iii)	Total Auxiliary power consumption of the following continuously running drives combined together for the Steam Generator (SG) island at 100 % TMCR as detailed below for each unit	kW	11190
	a) Mills b) FD fans c) ID fans d) RAPHs e) Electrostatic Precipitator (Corona Power) f) Boiler water circulating pumps g) Seal Air Fans - Not applicable h) Lignite Feeders i) ABGs j) Submerged Scrapper Chain Conveyor k) Bottom Ash Overflow Recycling System Equipment	kW	The auxiliary power consumption guaranteed above is restricted to the auxiliaries listed in Sl.No. (iii) (a) to (k) only.

Section – B: Performance Guarantees Under Correction

Part -1: Mandatory requirement under Correction category:

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
a)	NOx emission for the entire operating range of steam generator for the range of fuel specified	Grams/gigajoule of heat input	260

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S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
b)	Dust concentration / Emission (maximum) at ESP outlet with any one field out of service at 100% TMCR for the (worst lignite specified) at 27°C ambient and minimum flue gas temperature of 150°C (corrected)	mg/Nm^3	50

Part -2: Requirement under Correction Category

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainity
a)	Steam temperature at main steam stop valve at 100% TMCR.	°C	540 ± 5
b)	Steam temperature at reheater outlet at 100% TMCR.	°C	568 ± 5
c)	Furnace exit gas temperature (Refer Volume IIA of Tender specification)	°C	As per Tender (By back working from Economiser outlet gas temperature)
d)	Reheater attemperation flow at 100 % TMCR firing design lignite	TPH	7.85
e)	Superheater attemperation flow at 100%TMCR	TPH	117
f)	Minimum rated stable load with lignite firing alone and without any oil support	%	40% BMCR
g)	Noise Level at a height of 1.5m above floor level in elevation and at a distance of one meter horizontally from the nearest equipment/ machine furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar.	dBA	85 dB(A) for continuously running equipments except for coal mills which will be 92 dB(A). Excluded from the noise requirements are the boiler transient conditions such as Boiler start-up and shut down, HP bypass operation, Pressure relief valve, safety valve operation and Air Motor for AH
h)	Capacity of Mill	TPH	100
i)	Lignite fineness while firing design fuel -lignite	%	a) 40% pass through 0.09 mm mesh screen. b) 80% pass through 0.3 mm mesh screen. (a) and (b) with new beater plates

Varun Jain S A Khan Praveen Kishore

SCHEDULE OF PERFORMANCE GUARANTEE PARAMETERS

FOR UNIT-II

Section – A: Performance Guarantees under Liquidated Damages [L.D]

S. No	Particulars	Unit	Value inclusive of design, manufacture and all other Tolerances including measurement uncertainty
(i)	Steam Generator efficiency while firing design lignite at rated steam parameters and rated excess air and other stipulated conditions at 100%TMCR i.e. 500 MW unit load	%	89.79 According to EN12952-15 (LHV basis, with 1.5% loss due to unburnt carbon)
(ii)	Steam Generator output at 100 % BMCR at rated steam parameters at superheater outlet (with any combination of mills working as per Purchaser's choice) while firing design lignite.	TPH	1600
(iii)	Total Auxiliary power consumption of the following continuously running drives combined together for the Steam Generator (SG) island at 100 % TMCR as detailed below for each unit	kW	11190
	a) Mills b) FD fans c) ID fans d) RAPHs e) Electrostatic Precipitator (Corona Power) f) Boiler water circulating pumps g) Seal Air Fans - Not applicable h) Lignite Feeders i) ABGs j) Submerged Scrapper Chain Conveyor k) Bottom Ash Overflow Recycling System Equipment	kW	The auxiliary power consumption guaranteed above is restricted to the auxiliaries listed in Sl.No. (iii) (a) to (k) only.

Section – B: Performance Guarantees Under Correction

Part -1: Mandatory requirement under Correction category:

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
a)	NOx emission for the entire operating range of steam generator for the range of fuel specified	Grams/gigajoule of heat input	260

Varun Jain S A Khan Praveen Kishore

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainty
b)	Dust concentration / Emission (maximum) at ESP outlet with any one field out of service at 100% TMCR for the (worst lignite specified) at 27°C ambient and minimum flue gas temperature of 150°C (corrected)	mg/Nm^3	50

Part -2: Requirement under Correction Category

S. No	Particulars	Unit	Value Inclusive of design, manufacture and all other tolerances including measurement uncertainity
a)	Steam temperature at main steam stop valve at 100% TMCR.	°C	540 ± 5
b)	Steam temperature at reheater outlet at 100% TMCR.	°C	568 ± 5
c)	Furnace exit gas temperature (Refer Volume IIA of Tender specification)	°C	As per Tender (By back working from Economiser outlet gas temperature)
d)	Reheater attemperation flow at 100 % TMCR firing design lignite	TPH	7.85
e)	Superheater attemperation flow at 100%TMCR	TPH	117
f)	Minimum rated stable load with lignite firing alone and without any oil support	%	40% BMCR
g)	Noise Level at a height of 1.5m above floor level in elevation and at a distance of one meter horizontally from the nearest equipment/ machine furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar.	dBA	85 dB(A) for continuously running equipments except for coal mills which will be 92 dB(A). Excluded from the noise requirements are the boiler transient conditions such as Boiler start-up and shut down, HP bypass operation, Pressure relief valve, safety valve operation and Air Motor for AH
h)	Capacity of Mill	TPH	100
i)	Lignite fineness while firing design fuel -lignite	%	a) 40% pass through 0.09 mm mesh screen. b) 80% pass through 0.3 mm mesh screen. (a) and (b) with new beater plates

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SECTION: C 2C

CUSTOMER SPECIFICATIONS

PAINTING SPECIFICATIONS

- All the Equipments shall be protected against external corrosion by providing suitable painting.

- The surfaces of stainless steel, Galvanised steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Bidder shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per the agreed procedure.

- For all the steel surfaces (external) exposed to atmosphere (outdoor installation), a coat of red oxide primer of thickness 30 to 35 microns followed up with three coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied.

- For all the steel surfaces inside the building (indoor installation), a coat of red oxide primer of of thickness 30 to 35 microns followed up with two coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied.

- However for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.

SECTION: C-3
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

Varun Jain S A Khan Praveen Kishore

2x500 MW NEYVELI NEW THERMAL POWER STATION (NNTPS)

TECHNICAL SPECIFICATION

FOR

VENTILLATION SYSTEM

(ELECTRICAL PORTION)

Varun Jain S A Khan Praveen Kishore

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

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

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

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

d) Erection and commissioning spares.

e) Erection & Maintenance tools & tackles.

f) Electrical load requirement for Air conditioning System.

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

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

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

j) Motor shall meet minimum requirement of specification AC/DC motors.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

a) A copy of this sheet "Electrical Equipment Specification for Ventillation System" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.

b) List of Erection and Commissioning spares.

c) List of Erection & Maintenance tools & tackles.

d) Electrical load requirement.

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

4.0 LIST OF ENCLOSURES

4.1 Electrical scope between BHEL & vendor.- 2 sheets.

4.2 Std. Technical specification for LV motors.- 5 sheets

4.3 Std. Technical specification for Cabling installation.- 6 sheets.

4.4 Data Sheets (A) for 415V Electric Motors.- 2 sheets.

4.5 Data Sheets (C) for 415V Electric Motors- 2 sheets.

4.6 Quality plan for motor below 75kW.- 2 sheets

4.7 Quality plan for motor above 75kW.- 9 sheets

4.8 Load data format.- 1 sheet

Varun Jain S A Khan Praveen Kishore

Scope sheet for Scope between BHEL & Vendor

PROJECT : 2 x 500 MW NEYVELI TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.

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Scope sheet for Scope between BHEL & Vendor

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.
18	Junction Boxes	Vendor	Vendor	

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

Varun Jain S A Khan Praveen Kishore

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement ofr rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechnical vibration of rotatinf electrical machines
IS:12615	**Energy Efficient Induction Motors - Three Phase Squirrel Cage**

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be sutable fro mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechnical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise statedin Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 **INSPECTION AND TESTING**

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 **DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement ofr rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechnical vibration of rotatinf electrical machines
IS:12615	**Energy Efficient Induction Motors - Three Phase Squirrel Cage**

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be sutable fro mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechnical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise statedin Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 **INSPECTION AND TESTING**

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 **DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

1.0	Design ambient temperature	:	50 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	160KW *
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V $\pm$ 10%
	b) Rated frequency (with variation)	:	50 Hz + 3 % to - 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 90 kW and above (Breaker controlled)	:	50 KA for 0.25 sec.
	o Below 90 kW (Contactor controlled)	:	50 KA protected by HRC fuse
	f) LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% of rated voltage
7.0	Power cables data	:	Shall be given during Detailed engg
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg
9.0	Space heater supply	:	240 V, 1¢ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
11.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615*
12.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
13.0	Makes	:	BHEL/ Customer approval
14.0	Paint shade	:	Shall be given during Detailed engg
15.0	Degree Of protection for motor/ terminal box	:	As per IS 4691

* **LT motors of continuous duty shall be energy efficient IE2 class conforming to IS12615**

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16.0 TESTING

16.1 Type Tests

For HT & LT Motors above 50kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening viz. February 2012 shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

16.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
		SECTION D
	DATA SHEET - C	REV NO. 00 DATE 01.08.14
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a) Voltage	
6	b) Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR				REV.	
			SEAL		
NAME	SIGNATURE	DATE			

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S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006/0			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 75KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.O	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-	-	
2.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	3	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	3	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	3	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	3	2,1	2,1	NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006/0			SPECIFICATION : TITLE :			
	SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 75KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	3	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 1 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	 W	 V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BROUGHT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	-	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	-	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	-	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	-	
		4.INTERNAL FLOWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO BREAKAGE ON OTHER PHY. DESIGN	-DO-	3	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	-	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3	-	-	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3/2	-	2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 4 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG.	MANFR'S DRG.	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
1.11	SLIP RING	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC.	MANUF'S SPEC.	-DO-	3	-	-	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	3	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	3	-	2	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	SIGNATURE		
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	3	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	3	-	-	
		3.CORE LOSS & HOTOPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	3	-	2	(FOR MOTORS OF 2MW AND ABOVE)
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	3	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	2	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	2	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	3	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	3	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	THREE DIPS TO BE GIVEN

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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	QUALITY PLAN	CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :					
		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE					
	SHEET 7 OF 9	SYSTEM		ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	3	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	-	
		2.SOUNDNESS	CR	MALLET TEST & MV TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	3	2	1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	3	2	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	3	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	3	-	2	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	3	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
	SHEET 8 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	3	1	1,2	NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	3	1,2	1,2	NOTE - 2
		3.VIBRATION	MA	-DO-	100%	IS-12075	IS-12075	-DO-	3	1,2	-	
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	3	2,1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	3	-	2,1	TC FROM AN INDEPENDENT LABORATORY NOTE-3
		6.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	3	2,1	-	
		7.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	3	-	2,1	NOTE-3
		8.PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	3	2,1	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE		
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION		VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION WITH THE CUSTOMERS, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

BHEL	LOAD DATA (ELECTRICAL)	JOB NO.	331	ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	2x500 MW NEYVELI NEW THERMAL POWER STATION (NNTPS)	NAME		DATA FILLED UP ON
		SYSTEM / S	VENTILLATION SYSTEM	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

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SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)

Varun Jain S A Khan Praveen Kishore

C&I SPECIFICATION

FOR

VENTILATION SYSTEM

FOR

2X500MW NNTPP (SG PACKAGE)

Varun Jain S A Khan Praveen Kishore

Specific Technical Requirements (C&I):

1.0 The control of Ventilation System shall be through PLC based control system having hot redundant Central Processing Unit. The PLC based control system shall be supplied under Air Conditioning Package. The operation and control philosophy of Air Conditioning System and Ventilation system has been elaborated in separate section in the specification. The PLC shall be common for both units, and shall be located in AC Plant Room. All the interface requirements of ventilation system which are to be hooked up with PLC in AC Plant Room shall be taken care by the bidder.

1.1 Bidder to keep the provision for accepting fire signals from Fire Alarm & Protection System and the closure of relevant fire dampers in Air Conditioning and Ventilation System.

1.2 The solenoid valves shall have limit switches for open/close feedback.

1.3 All electrical actuators shall be of non-integral starter type.

1.4 Interface of MCC, HT SWGR, field instruments, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification.

1.5 All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope.

1.6 Communication to main plant DCS for monitoring shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link.

1.7 Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification.

1.8 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

1.9 Following documents to be furnished by the bidder along with the bid:

- List of drives pertaining to Ventilation System
- I/O List for Ventilation System
- Duly stamped and signed copy of Quality Plan.

1.10 Drawings/Documents and data to be furnished after award of the contract:

- Operation & Control Philosophy for Ventilation system
- Recommended logic diagram/ write up for Ventilation system
- Input/Output signal list.
- Cable schedule and cable interconnection drawing.
- Instrument schedule.
- Instrument Data sheets.
- Any other document decided during detailed engineering.

LIST OF VENDOR DELIVERABLES FOR C&I FOR VENTILATION SYSTEM (2 X 500 MW NNTPP- SG PACKAGE)						
DOCUMENT NUMBER PE-GL-400-145-I100					SHEET	1 of 1
Sl.No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**	**CAT OF APPROVAL BHEL**	**FROM**	**USER**	**REMARKS**
1	PE-V9-400-554-I901	INSTRUMENT DATA SHEETS	A	VENDOR	C&I	
2	PE-V9-400-554-I902	INSTRUMENT SCHEDULE	I	VENDOR	C&I	
3	PE-V9-400-554-I903	INSTRUMENT HOOK UP	A	VENDOR	C&I	
4	PE-V9-400-554-I904	FIELD JB TERMINATIONS	I	VENDOR	C&I	
5	PE-V9-400-554-I905	QUALITY PLANS/CHECK LISTS (For all applicable instruments)	A	VENDOR	C&I	
6	PE-V9-400-554-I914	CONTROL SCHEMES (BLOCK LOGIC)	A	VENDOR	C&I	
7	PE-V9-400-554-I924	LIST OF SIGNAL EXCHANGE WITH DCS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	VENDOR	C&I	
8	PE-V9-400-554-I925	PROCESS GRAPHIC MANUSCRIPTS PLC	I	VENDOR	C&I	
9	PE-V9-400-554-I926	PROCESS GRAPHIC MANUSCRIPTS FOR DCS	I	VENDOR	C&I	
10	PE-V9-400-554-I927	CABLE SCHEDULE & INTERCONNECTION	I	VENDOR	C&I	
11	PE-V9-400-554-I928	ANNUNCIATION LIST	A	VENDOR	C&I	
12	PE-V9-400-554-I929	POWER DISTRIBUTION SCHEME	A	VENDOR	C&I	
13	PE-V9-400-554-I932	BILL OF MATERIAL INCLUDING MANDATORY SPARES	A	VENDOR	C&I	
	Notes:					
	1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.					

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BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	
	OFFER REFERENCE	
	* TAG NO. SERVICE	
	* DUTY	☐ ON / OFF ☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL	
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY
	* OPENING / CLOSING TIME	
	* WORKING PRESSURE	
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, DUST TIGHT, WEATHER PROOF, IP:67
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM
HANDWHEEL	* REQUIRED	■ YES ☐ NO
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION**.**	
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY
	@ MOTOR TYPE	IE1 TYPE AS PER IS: 12615, SQUIRREL CAGE INDUCTION MOTOR SUITABLE FOR DOL STARTING.
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) ■ DRG. NO. 4-V-MISC-90271 R11
	COLOUR SHADE	■ BLUE (RAL 5012), To be decided during detail engg.
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ■ EPOXY ☐ …….
	SHAFT RPM	BIDDER TO SPECIFY
	OLR SET VALUE	BIDDER TO SPECIFY
	@ STARTING / FULL LOAD CURRENT	600% OF FLC INCLUSIVE OF **I.S.** TOLERANCE
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC DOL STARTER
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V
	@ ENCLOSURE CLASS OF MOTOR	■ IP 67 ☐ FLAME PROOF
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B

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BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ■ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS	
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐……	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED	
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED	
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	☐REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER	
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	■1 No ☐2 Nos. / 2 Nos. (ADJ.) / ■1 No. ☐2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

Varun Jain S A Khan Praveen Kishore

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 3 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐ ……	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING	FOR MOTORS WITH RATING >30 KW	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐……	
	@ EARTHING TERMINAL	8 SWG GI WIRE	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ■ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:DDE	
	@ SPACE HEATER CABLE GLAND	SIZE:DDE	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE: 1no., 2.5 sq. mm	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS 12615 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL, WITH NICKEL COATING SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

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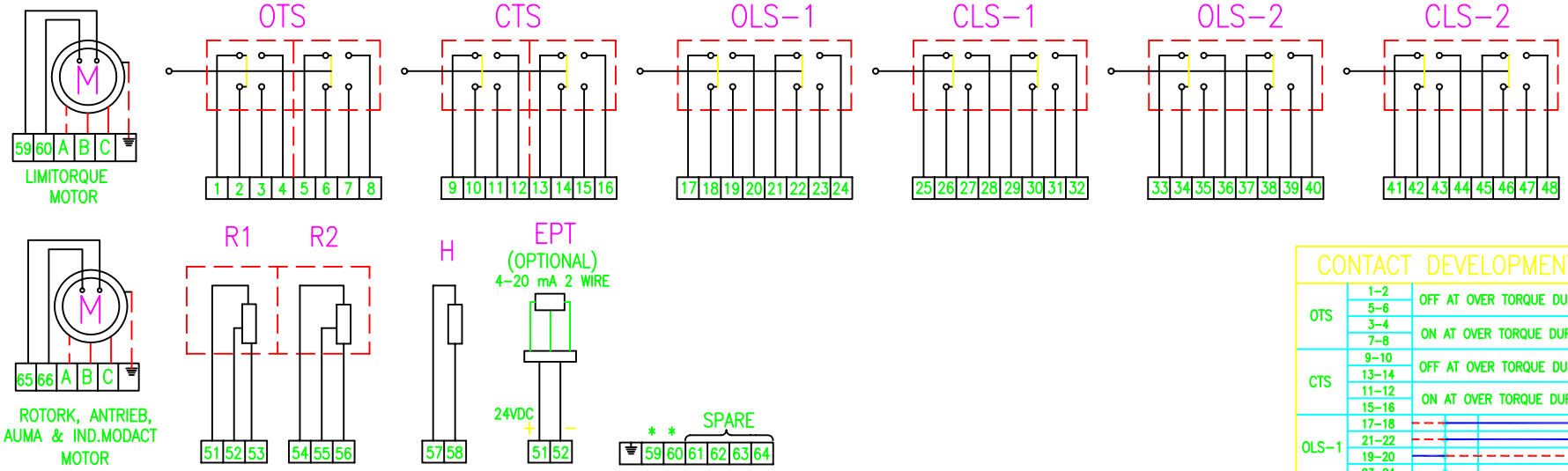


* – SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES – ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY

THERMOSTAT – 65–66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59–60 (LIMITORQUE).

EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS – TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE) – 2 NO+2 NC

OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN) – 2 NO+2 NC

OLS–1, OLS–2 – LIMITSWITCHES FOR POSITION OPEN – 2 NO+2 NC

CLS–1, CLS–2 – LIMITSWITCHES FOR POSITION CLOSE – 2 NO+2 NC

OTS, CTS – TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

OLS–2 & CLS–2 – CAM DISC IN ROTORK & ANTRIEB

R1–R2– POTENTIOMETER 2 x 100 OHMS

H – SPACE HEATER 1ø 240V AC SUPPLY

M – MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

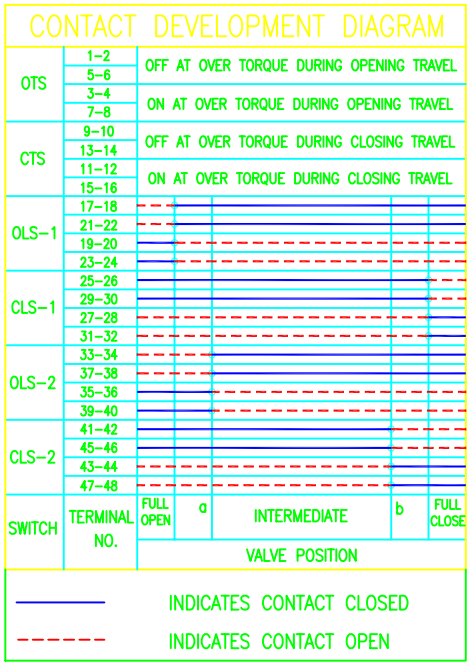
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	@

@ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM



CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

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REV	DATE	CHED	APPD	DESCRIPTION
11	09.09 2000			CONTACT DEV. FIG.ADDED.

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

365-139

DRAWN	N.P.ESWAR
CHECKED	K.ARUNACHALAM
APPROVED	P.LOGANATHAN
DATE	09.09.2000

TITLE

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

DRAWING No. 4–V–MISC–90271 REV 11

RETRACED WITH REVISION 11

9. FIELD INSTRUMENTS & FINAL CONTROL ELEMENTS

9.1 General Requirements

1. Measuring instruments/equipment and subsystems offered by the Contractor shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Owner's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, make/ numbers as approved by the Owner during detailed engineering.
2. Every panel mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
3. All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided.
4. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tappings where the pressure exceeds 40 kg/sq cm.
5. For protection purposes, transmitters can be considered in place of switches.

9.2 Pressure / Differential Pressure / Flow / Level Transmitter

Table 9.1

Specifications for Pressure / Differential Pressure / Flow / Level Transmitter

S.N	Features	Minimum Requirements
1	Type	Microprocessor based 2 wire type, HART protocol compatible
2	Sensor Type	Capacitive/ Piezo-electric
3	Output Signal	4-20 mA signals superimposed with HART signal.
4	Signal Processing Unit	Microprocessor based

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S.N	Features	Minimum Requirements
5	Overpressure	150% of max. operating pressure. For vacuum service, the element shall have under – range protection to full vacuum
6	Turn-down Ratio	10:1 for vacuum / very low pressure applications. 100:1 for other applications.
7	Stability	± 0.1% of calibrated span for six months up to 70 Kg/cm² and ± 0.25% for range more than 70 Kg/cm²(g).
8	Span and Zero drift	± 0.015% per deg. C at max span & 0.11% per deg. C at min. span.
9	Enclosure Class	Weather proof as per IP 67 with corrosion resistance coating. For hazardous area explosion proof enclosure as described in NEC article 500
10	Zero & span adjustability	Continuous, tamper proof, remote as well as manual from instrument with zero suppression and elevation facility.
11	Local Indicator	To be provided
12	Display	Digital LCD Integral Display (minimum 5 digit) Engineering Unit
13	Process connection	½" NPT (F)
14	Electrical Connection	½ " NPT
15	MOC of Electrical Housing	Aluminum Alloy or better
16	Ambient Temperature	65 Deg. C
17	Operating Voltage	16 – 40 Volts DC
18	Load	600 Ohms (minimum) at 24 Volts DC
19	Accuracy	± 0.075% of span or better
20	Response Time	100 millisecond or better
21	Adjustment/ calibration/ maintenance	Port/provision for Centralised PC based system maintenance.

1. All transmitters shall be equipped with all necessary accessories like valve manifolds, mounting bracket etc. Pulsation dampeners shall be used where the process media is unstable for measurement such as at the discharge of a pump. For absolute pressure transmitter, 2 valve manifold; for gauge / vacuum pressure transmitter, 3 valve manifolds and for DP / level / flow transmitter, 5 valve manifold shall be provided. In case if it becomes necessary to use a DP transmitter for pressure measurement then a 3 valve manifold shall be used in place of 2 valve manifold.
2. Pressure transmitter shall have easily accessible span, zero and time constant adjustments. A range suppression / elevation device shall be provided wherever required.
3. For pressure / differential pressure transmitter, proof pressure shall be 200% of maximum static process pressure.
2. All transmitter cases shall be dust – tight and rugged. Weather – proof and explosion – proof cases shall be used in outdoor and hazardous areas respectively. Protection class shall be of IP 67 or better.

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