



SECTION – VI

TECHNICAL SPECIFICATION (TS)

PART-A

FOR

50 MW GAS POWER PROJECT
AT
HOPE TOWN, PORT BLAIR, ANDAMAN AND NICOBAR

IFB DOCUMENT NO. : 'NVVN/C&M/RE-53/2020-21'

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ANDAMAN & NICOBAR GAS POWER PROJECT (50MW)
TECHNICAL SPECIFICATION

SECTION – VI

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(PART-A)

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INTENT OF SPECIFICATION

PART-A

VOLUME - I

INTENT OF SPECIFICATION

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INTENT OF SPECIFICATION

1.00.00 INTENT OF SPECIFICATION

1.01.00 Scope of the Proposal

The scope of the proposal for Engineering, Supply, Construction, Erection, Testing & Commissioning works for Andaman & Nicobar Gas Power Project (50 MW $\pm$ 10%) shall be on the basis of a single point responsibility, completely covering the following activities and services in respect of all the equipment specified and covered under the specifications and read in conjunction with "Scope of Supply & Services", Volume-III, Part-A, Section –VI of Technical Specification.

- i) Basic Engineering of the plant including preparation of plant design manuals for the power project.
- ii) Detailed design of all the equipment and system(s) including civil, structure steel works included in bidder's scope for the Project.
- iii) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings, O&M manuals and other information for Employer's approval.
- iv) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required.
- v) Complete manufacturing including shop testing/type testing.
- vi) Complete civil, structural and Architectural works, including topographical survey, providing construction offices, field laboratory, construction equipment, construction power and construction water.
- vii) Packing and transportation from the manufacturer's work to the site including customs clearance/port clearance, port charges, if any.
- viii) Receipt, storage, preservation and conservation of equipment at the site.
- ix) Fabrication, pre-assembly, if any, erection, testing and putting into satisfactory operation all the equipment including successful completion of facilities.
- x) Reliability tests and owner acceptance including the tests for performance demonstration after successful completion of facilities.
- xi) Furnishing of spares on FOR site basis.
- xii) Reconciliation with customs authorities, in case of Foreign bidders.
- xiii) Satisfactory conclusion of the Contract.
- xiv) Insurance and other requirements for the complete Power plant package in accordance with the provisions of general conditions of contract (Section-IV) of the bidding document.
- xv) Operation and Maintenance of Power Plant including spares & consumables for the period of 03 years after take-over of the plant, post successful completion of initial/trial operations & Performance guarantee tests including Demonstration tests (whichever occurs later).

The Power plant is expected to run for its life on RLNG as fuel for the project.

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INTENT OF SPECIFICATION

- 1.02.00** The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to complete the project and fulfill the intent of ensuring operability, maintainability and reliability of the complete work covered under this specification. It is not the intent to specify completely herein, all aspects of design and construction; nevertheless, the equipment and works shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to Employer, who will interpret the meaning of the specification, drawings, operation of equipment, maintenance redundancy etc. and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable National and International standards mentioned elsewhere in the specification or otherwise.
- 1.02.01** Bidder is requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Such clarifications should be within the time period as stipulated in ITB. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the Conditions of Contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Employer in writing before the award of this contract, based on a written request from the Bidder for such a clarification. However, if the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately.
- 1.02.02** The Bidder may also make alternate offers provided such offers are superior in his opinion, in which case, adequate technical information, operating feed back, etc. shall be enclosed with the offer, to enable the Employer to assess the superiority and reliability of the alternatives offered. In case of each alternate offer, its implications on the performance, guaranteed efficiency etc. shall be clearly brought out for the Employer to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications. Under no circumstances the specified equipment and services as specified herein shall be brought out as an alternative offer. In case, all the above requirements are not complied with, the offer may be considered as incomplete.

PROJECT INFORMATION

PART-A

VOLUME – II

PROJECT INFORMATION

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PROJECT INFORMATION

1.01.00 Introduction

- 1.01.01 NVVN, New Delhi is planning to setup a power plant of approx. 50 MW capacity at Hope Town, Port Blair, Andaman & Nicobar Islands. Re-gasified Liquefied Natural Gas (RLNG) shall be the fuel for the project.
- 1.01.02 Power generation shall be with RLNG fired engine sets. The Net Capacity of Plant shall be 50 MW $\pm$ 10% (45 MW to 55 MW) with 4 to 6 nos. of identical units.
- 1.01.03 Further to the information given in the following paragraphs, bidders are advised to visit the project site and collect data on local conditions as required for making a comprehensive and fully compliant bid in accordance with the requirements of various sections of bid documents including Technical Specifications.

1.02.00 Site Location

- 1.02.01 The project site is located in Hope Town at Ferrargunj Tehsil in South Andaman District of Andaman & Nicobar Islands. Nearest National Highway NH-223 is at a distance of 8 km in North direction. Nearest major city is Port Blair located at a distance of 7.9 km south to the project site.

The Site is located at latitudes of 11° 41' 43" N and longitudes of 92° 43' 40"E respectively.

1.03.00 Approach to Site

The site can be approached from coastal road linking Bamboo Flat & Hope Town and through water ways. The nearest airport is Veer Savarkar International Airport, Port Blair at a distance of about 4.5 Km from project site.

1.03.01 Airport

Nearest commercial Airport	Veer Savarkar International Airport	About 4.5 Km
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1.03.02 Sea Ports

Nearest Commercial Port	Govt. of India has notified 23 ports in the Andaman & Nicobar Islands. However, the Main Shipping activities are carried out at Port Blair. Eight ports are in other islands viz. Diglipur, Mayabunder, Rangat, Hut Bay, Car Nicobar, Katchal & Campbell Bay and these ports are notified as Wharfage ports.
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Ports	Chennai Port	About 1350 Km
	Vishakhapatnam Port	About 1200 Km
	Kolkata Port	About 1255 Km

1.04.00 Land Availability

Proposed site at Hope Town, about 2 Acres of polygon shaped waste and barren land (Survey No- 41) having irregular topography exists along the seashore. The Site having elevation varying from 4m to 12m above MSL is flanked between Sea on front side & stiff rock Hill on backside. The power project is proposed to be accommodated within the

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PROJECT INFORMATION

available land (approx. 2 Acres) located in Hope Town. For further details General Layout Plan (GLP) attached with Technical Specification may be referred.

1.05.00 Fuel

Fuels envisaged for the proposed power plant is RLNG.

1.05.01 RLNG

Employer shall make RLNG available at a terminal point within plant premises. Expected composition of RLNG shall be as indicated at Annexure-IA, Volume-II, Part-A of 'Project Information'. Further, bidder shall make arrangements for suitability of RLNG pressure as per requirement of the offered Engines.

1.06.00 Water Availability

1.06.01 Source

The Make up water requirements for the project will be drawn from Sea by Sea water Intake Pumps.

Provision of Roof Top Rain Water harvesting shall also be kept for the plant for collection of rain water to be used for make-up.

1.06.02 Quality of Raw Water

Expected quality of Sea water to be supplied to the Plant shall be as indicated at Annexure – II of 'Project Information'. However, Bidder to perform analysis for determination of actual sea water quality.

1.07.00 Meteorological Data

1.07.01 Climatological data for the nearest observatory at Port Blair as published by the Meteorological Department, Government of India shall be as per Annexure – III of 'Project Information'.

1.08.00 Wind Design Criteria

Criteria for Wind resistant design of structures and equipment shall be as per Annexure-IVA & IVB.

1.09.00 Earthquake Design Criteria

Criteria for earthquake resistant design of structures and equipment shall be as per Annexure-V.

PROJECT INFORMATION

ANNEXURE - IA

EXPECTED SPECIFICATION OF RLNG

	Particulars	Unit	Minimum	Maximum	Typical
1.	COMPOSITION				
	a. Methane (C1)	% Molar	88.0	98.5	93.0
	b. Ethane (C2)	% Molar	1.5	6.0	3.35
	c. Propane (C3)	% Molar	-	3.5	1.75
	d. Butane (C4)	% Molar	-	2.0	1.0
	e. Pentane (C5) & heavier	% Molar	-	0.1	0.1
	f. Nitrogen	% Molar	-	1.0	0.8
2.	Gross Heating Value	Kcal/standard m ³	8994	10508	-
3.	Pressure	Bar (g)	8	10	-
4.	Temperature	Degree C	25	35	-
5.	Moisture	Kg/Million SM3		112	
6.	Impurities				
	a. Carbon dioxide	ppm – mole	-	100	
	b. Oxygen	ppm – mole	-	50	
	c. Hydrogen Sulphide	mg/Nm3	-	5	
	d. Mercaptan Sulphur	mg/Nm3		7	
	e. Total Sulphur (including mercaptans)	mg/Nm3		30	
6.	CONTAMINANTS				
	Trace Metals				
	i. Pb + Zn	ppm (wt)	-	0.50	
	ii. Na + K	ppm (wt)	-	0.30	
	iii. Vanadium	ppm (wt)	-	0.50	
	iv. Calcium	ppm (wt)	-	2.0	
	v. Magnesium	ppm (wt)	-	2.0	
	vi. Sum of heavy metals	ppm (wt)	-	1.0	

Note: Typical composition has been given only as a reference condition for Performance Guarantee (refer clause 3.01.00, Volume – IV). Actual composition of the gas generally may be anything within the range indicated. However, the engine shall also be designed to run on gas fuel with methane no. corresponding to at least (-)10% of the methane number calculated on the minimum composition mentioned here above.

PROJECT INFORMATION

ANNEXURE - II

INDICATIVE SEA WATER ANALYSIS OF WATER FOR A & N GAS POWER PROJECT

Sl. No.	Parameter	MW3 Hope Town Wharf
i	Latitude-Longitude	11°41'49.94"N 92°43'25.66"E
ii	Sampling Period, hrs.	07:45-08:00
1	pH	8.08
2	Colour, Hazen Units	No noticeable color
3	Odour (as perceived)	No offensive odour
4	Floating Materials	No Visible Solids
5	Temperature, °C	27.5
6	Salinity, ppt (Surface)	31.2
7	Turbidity, NTU	1.0
8	Dissolved Oxygen (min.), mg/l	5.6
9	Total Suspended Solids, mg/l	18
10	Electrical Conductivity, umhos/cm	46000
11	Total Dissolved Solids, mg/l	34500
12	Total Hardness (as CaCO ₃), mg/l	6300
13	Calcium Hardness (CaCO ₃), mg/l	2100
14	Magnesium Hardness (CaCO ₃), mg/l	4200
15	Calcium (as Ca), mg/l	840
16	Magnesium (as Mg), mg/l	1008
17	Sodium (as Na), mg/l	9300
18	Potassium (as K), mg/l	240
19	Chlorides (as Cl), mg/l	19200
20	Sulphates (as SO ₄), mg/l	2050
21	Total Alkalinity (as CaCO ₃), mg/l	120
22	BOD-3 days, 27°C, mg/l	2
23	COD, mg/l	70
24	Oil & Grease, mg/l	Nil
25	Fluorides (as F), mg/l	0.91
26	Nitrates (as NO ₃), mg/l	0.18
27	Phosphates (as PO ₄), mg/l	0.24
28	Free Ammonia (as N), mg/l	0.08
29	Nitrites (as NO ₂), mg/l	0.21
30	Chlorinated Hydrocarbons (as Cl), mg/l	Nil
31	Phenols (as C ₆ H ₅ OH), mg/l	Nil
32	Iron (as Fe), mg/l	0.12
33	Manganese (as Mn), mg/l	0.02
34	Copper (as Cu), mg/l	0.01
35	Zinc (as Zn), mg/l	0.02
36	Mercury (as Hg), mg/l	<0.0001
37	Cadmium (as Cd), mg/l	<0.01
38	Chromium (as Cr ⁶⁺), mg/l	<0.01
39	Lead (as Pb), mg/l	<0.01
40	Arsenic (as As), mg/l	<0.01
41	Percent Sodium, %	75.4
42	Total Coliforms, MPN/100 ml	40
43	Phytoplanktons, Nos./l	2400
44	Zooplanktons, Nos./cu.m	5700

PROJECT INFORMATION

स्टेशन : पोर्टब्लेअर
STATION : Port Blair

जलवायवी सारणी
CLIMATOLOGICAL TABLE

मौसम वर्गीकरण										वर्षा										हवा										दृश्यता									
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PROJECT INFORMATION

ANNEXURE - IVA

A & N GAS POWER PROJECT

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

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

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

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

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

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

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

Damping in Structures

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

- | | | |
|-----------------------------------|---|--|
| a) Welded steel structures | : | 1.0% |
| b) Bolted steel structures | : | 2.0% |
| c) Reinforced concrete structures | : | 1.6% |
| d) Steel-stacks | : | As per IS: 6533 & CICIND Model Code, whichever is more critical. |

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PROJECT INFORMATION

ANNEXURE - IVB

SITE SPECIFIC DESIGN PARAMETERS

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

- a. The basic wind speed " V_b " at ten metres above the mean ground level 44 metres/ second
- b. The risk coefficient "K1" 1.07
- c. The risk coefficient "K4" 1.15
- d. Category of terrain Category-1

Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/M^2 for all classes of structures, i.e. A, B & C, as defined in IS: 875 (Part-3).

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PROJECT INFORMATION

ANNEXURE - V

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ANDAMAN & NICOBAR GAS POWER PROJECT

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

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

Site falls in Seismic zone V.

Damping in Structures

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

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

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PART-A

VOLUME - III

**SCOPE OF SUPPLY & SERVICES, TERMINAL
POINTS AND EXCLUSIONS**

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SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

1.00.00 GENERAL

- 1.01.00 Scope of Work in respect of equipment and systems mentioned herewith shall be in accordance with the provisions of various sections of Technical Specifications and such as to deliver a fully operational plant that meets the Intent of the Specification.
- 1.02.00 The Scope of Work shall include Planning, Design, Engineering, Manufacture, Fabrication, Assembly, Pre-shipment Testing at manufacturer's works, Packing, Transportation, Handling, Delivery at Plant Site, Storage, Installation, Interconnection with related plant and equipment, Pre-Commissioning, Commissioning, Initial Operation, Conductance of Acceptance Tests and subsequent O&M for 03 (three) years of the Plant.
- 1.03.00 This Volume describes only the brief scope for Supplies and Services. However, the Scope includes all such material, equipment and services which may not be specifically stated in the specifications but required for completeness of the equipment/ systems for meeting the Intent of Specification and Specification requirements. The work shall be consistent with modern practices and shall comply with all applicable codes, standards, guidelines and safety requirements in force as on the date of award of the contract.
- 1.04.00 The bidders are requested to submit their offer with best ratings and specifications. Ratings of any items, equipments or auxiliaries, building space, that are not asked to be specified in the technical proposals shall be decided at the time of according approval to design basis reports, drawings and specifications, during project execution. The bidder shall be presumed to have considered all items and its' ratings in his supply scope in his bid. Increase of price on account of difference in any items and its' ratings between those estimated by the bidder and those approved by the Employer shall not be allowed whatsoever.
- 1.05.00 In the event of conflict between requirements of any two clauses of specification, Employer's discretion shall apply unless otherwise confirmed by the Employer in writing before the award of the contract, based on a written request from the Contractor.
- 1.06.00 Contractor shall provide all equipments, devices and systems on as required basis subject to the minimum quantities indicated in the following clauses.

2.00.00 ENGINE GENERATOR SETS AND AUXILIARIES

- 2.01.00 The net capacity of Plant shall be 50 MW $\pm$ 10% (45 MW to 55 MW) with 4 to 6 nos. of identical units.
- 2.02.00 Each Engine-Generator set (Genset) shall necessarily include but not be limited to the following:
- All Stationary and Rotating Components of Engine
 - Rotor Support System (Bearings etc.) and all interconnecting couplings
 - Engine Exhaust system
 - AC Generator along with excitation system
 - Foundation Bolts, Base Plate and Support Structures
 - Any other component/system as per the standard proven practice and as required for the Genset model offered.

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2.03.00 Integral Auxiliaries and Support Systems for each Genset

Integral Auxiliaries for Genset shall necessarily include the following:

- i. Lube Oil System complete with Pumps, Filters, Coolers, oil purifying system, Valves and Piping.
- ii. Turbocharging system
- iii. Governing System
- iv. Protective Devices
- v. Combustion system
- vi. Gaseous-Fuel Supply and Metering System complete with Last Chance Filter, Piping, Stop/ Control Valves and Distribution Headers etc.
- vii. Start up system including Start up Air compressor & Air Bottle/ Start up system including Start up Air compressor & Air Bottle(s) (Common for all engines)
- viii. Turning Gear system
- ix. Engine Cooling Water systems
- x. Gas leakage Detection system
- xi. Air Intake System
- xii. Equipment Cooling water system complete with all required piping and valves
- xiii. 1no. of EOT crane as per IS 3177 (Common for all the engines) capable of lifting 105% of the single heaviest equipment/components (Except Gas Engines) including lifting beam and slings etc. (as applicable) for maintenance and loading/unloading in the engine hall. However, min. 5 Tons capacity EOT cranes to be provided.
- xiv. Waste liquid collection and disposal system
- xv. Common or Unitized NOx control system as per standard proven practise of the engine OEM
- xvi. Any other system required for continuous and trouble free operation of Engines in all the specified operating regimes and ambient conditions.

2.04.00 Equipment and systems mentioned above shall be in accordance with the specification requirements of Part B and relevant clauses of Part A of Section VI of Technical Specification.

3.00.00 GAS ENGINE EXHAUST SYSTEM

3.01.00 Gas Engine Exhaust System

Complete ducting system from the gas engine outlet to the Chimney. This will include Exhaust gas silencers, Expansion bellows, Rupture Discs, Exhaust Duct insulation and Supports etc.

Provision of blind flange with proper sealing to be kept in the Exhaust lines of Engines to facilitate installation of future Heat Recovery system.

3.02.00 Valves/Gates/Dampers

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All necessary isolating, regulating, check and relief valves, gates and dampers etc.

3.03.00 Steel Stack

- i. Stack suitable to discharge flue gases at height of "H" meters (calculated as $H = 14XQ^{0.3}$, where Q = SO₂ emission in Kg/hour) from the finished grade level and complying CPCB and MoEF&CC norms subject to minimum height of 30 meters.
- ii. Each stack shall be provided with complete supporting structure.
- iii. Each stack shall be provided with continuous online NO_x, SO_x, CO & CO₂ analyzer equipment. Suitable approach and platform for these shall also be provided. NO_x, SO_x, CO₂ and CO values shall be made available in CCR through required instrumentation.

4.00.00 Supporting Steel Works

- i. All supporting steel works for Gensets and its auxiliaries.
- ii. Necessary structural steel for stack, Dampers, ducting roof, weather canopies and the platforms at the sides of the Gensets and in other areas.

5.00.00 All Galleries, walkways and Platforms

These shall comply with all safety requirements as detailed in Volume – IV (Part A, Section VI) and relevant equipment specifications (Part B, Section VI).

6.00.00 Thermal Insulation

All necessary Insulation including cladding, lagging, reinforcement, wire mesh, cleats, supports etc. for Engines (if applicable), piping, valves ducting, stacks etc. conforming to the requirements as brought out in the equipment specifications.

7.00.00 Pipes and fittings

- i. Piping, fittings, plugs, stubs, flanges and other accessories for the piping systems identified above and as per approved schemes.
- ii. All standard and non-standard matching pieces as needed within piping systems and for connection of piping systems to various equipments/ tanks/ vessels/ valves etc.
- iii. Pipe stubs for mounting thermowells and other instrumentation along with necessary reducers/ matching pieces and instrument tubing.

8.00.00 Paint and primers as required and suitable for the environment/conditions prevailing at site.

9.00.00 Miscellaneous Erection and Cleaning Material

- i. All erection material such as bolts, nuts, washers, gaskets, electrodes, filler materials, welding gas, consumable inserts and backing rings, accessories and miscellaneous specialties required for the proper installation of piping, ducting and all systems.
- ii. All valves, tanks, pumps, chemicals, caps, blanking plates, spool pieces, auxiliary structural steel, flow nozzles & specialties and other accessories as required to complete, chemical cleaning operation and hydro testing of piping systems as per specification and approved schemes.

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- iii. Weather hood for pipes crossing ceilings and walls.
- iv. All other materials required for completing the erection, testing & commissioning.

10.00.00 FUEL GAS SYSTEM

- 10.01.00 RLNG shall be made available by the owner/client within the plant premises. If required, Bidder shall make necessary arrangements for level of gas pressure required for the offered Gas Engine(s). Bidder shall provide common Gas flow meter (common to all Engines) as well as individual gas flow meter for each Gas Engine as per relevant standards. Location of above meters shall be finalized during detailed Engineering.
- 10.02.00 Fuel Gas System
 - i. Emergency Stop Valve (which can be operated remotely from control room) at the inlet to the system to cut-off supply of gas to the power station in case of emergency. Further manual isolating valve shall also be provided at the inlet of Gas terminal point.
 - ii. Any other system/equipment required to meet the intent of specification.

11.00.00 WATER SYSTEM

11.01.00 GENERAL INFORMATION

- 11.01.01 Intake water system and desalination system shall be provided as specified in this specification and shall meet the requirements of 50 MW RLNG fired Power generating unit.
- 11.01.02 Indicative Sea water analysis is attached herewith as annexure-II of Project information chapter of Part A of Section VI. However, the bidder shall carry out sea water analysis to finalize selection and design of desalination RO plant.

11.02.00 SCOPE OF WORK

The scope of the equipment to be furnished & erected under this specification is detailed hereunder. The items though not specifically mentioned but are needed to make the equipment / system complete and safe from operational view point, shall also be furnished and erected unless otherwise specifically excluded.

- a) Three (3) Number (2W + 1S) of horizontal centrifugal/ vertical Sea water Intake pumps, associated motor drive complete with all accessories such as base plate, sole plate, foundation bolts and nuts, anchor, sleeves, stuffing boxes (if applicable), thrust pads etc. as required and associated civil works.
- b) Complete desalination system consisting of two (2) number (2 X 100%) of Reverse Osmosis (RO) skid to meet service water, potable water and process water requirement.
- c) Complete Chlorination system. Gas chlorination is not allowed.
- d) HDPE Piping, butterfly valves, fittings, accessories etc. from sea water intake pumps to Desalination plant.
- e) Two (2) number Sea water storage tank each of capacity 15m³.

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- f) Two (2) number desalinated water Storage tank each of capacity 5 m³.
- g) One (1) number CMB tank of capacity 15 m³.
- h) Two (2) number (2X100%) of horizontal centrifugal pumps for service water and process water application, associated motor drive complete with all accessories such as base plate, sole plate, foundation bolts and nuts, anchor, sleeves, stuffing boxes (if applicable), thrust pads etc. as required and associate civil works.
- i) Two (2) number (2X100%) of horizontal centrifugal pumps for potable water application, associated motor drive complete with all accessories such as base plate, sole plate, foundation bolts and nuts, anchor, sleeves, stuffing boxes (if applicable), thrust pads etc. as required and associated civil works.
- j) Effluent treatment system consisting of clarifier/tube settler, oil water separation system etc. to make waste water usable, to the extent possible and to comply with CPCB/SPCB norms for final discharge of remaining water into sea.
- k) Two (2) number (2X100%) of horizontal centrifugal pumps for waste water handling, associated motor drive complete with all accessories such as base plate, sole plate, foundation bolts and nuts, anchor, sleeves, stuffing boxes (if applicable), thrust pads etc. as required and associate civil works.
- l) Suitable Shed and handling arrangement (as required) for sea water intake pumps, service water pumps, potable water pumps and waste water pumps.

12.00.00 PLANT AUXILIARY SYSTEMS

12.01.00 COMPRESSED AIR SYSTEM FOR INSTRUMENT & SERVICE AIR APPLICATION

- a) Two (2) numbers (2x100%) oil free, rotary screw type air cooled air compressors for instrument air and service air applications for complete plant each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Volume-IV (Plant Performance & Design Philosophy), Part-A of Technical Specification. However, minimum capacity of each air compressor shall be 5 Nm³/min at discharge pressure of 8.0 Kg/cm² (g).
- b) Two (2) numbers (2x100%) air cooled Air Drying Plants (one for each air compressor) of adequate capacity with all interconnecting piping, valves, fittings, etc.
- c) One number of Air Receiver of capacity 2 m³ at the discharge of each Air compressor. (Total: 2 numbers)
- d) Complete instruments, control system with panels as required for compressor
- e) Any additional items required to make the system complete.
- f) For detailed specification of Compressed air system and selection of the required capacity and discharge pressure of Air compressors, please refer Part-B of technical Specification.

12.02.00 FIRE DETECTION AND PROTECTION SYSTEM

The fire detection and protection system shall consist of:

- a) **Fire Water Pumping System**

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Complete fire water pumping system consisting of two (2) nos. fire water storage tank, fire water pumps & drives (Common for hydrant system and spray system), batteries and Battery Chargers for the diesel engines drives, automatic pressurization system consisting of electric motor driven Jockey pumps, required instruments, controls, and panels as per the detailed specifications in Part-B of technical specification.

b) **Hydrant System**

Hydrant system for complete power plant covering main plant building, switchyard-transformer area, all pump houses and various miscellaneous buildings of the plant, etc. as per the detailed specifications in Part-B of technical specification.

c) **HVW Spray System**

Automatic fire detection cum high velocity water spray system for various transformers, lube oil tanks and purification unit, feed pumps of lube oil system, etc.

d) **MVW Spray System**

Automatic fire detection cum medium velocity water spray system for the various cable galleries in Main plant and switchyard building, DG set oil tanks, etc. as per the detailed specifications in Part-B of technical specification.

e) **Inert Gas Extinguishing System**

Automatic gaseous fire extinguishing system using inert gas agent as per NFPA-2001 for control room, control equipment rooms and associated C&I rooms like programmer/server rooms, PC rooms, panel room, UPS/Battery charger rooms of Main plant building as per the detailed specifications in Part-B of technical specification.

f) **Control System for Fire Detection & Protection**

Fire detection & protection control system shall consist of PLC based control system, Analogue addressable fire alarm system consisting fire alarm panels, repeater panel, various types of fire detectors, control cabling, centralized monitoring station etc.

PLC based control panels

- i) Dual processor PLC based control system with two OWS and one A4 size color Laser printer for fire water pumps and associated systems located in main fire water pump house.

Fire Alarm System

Bidder to provide fire detection system as described below:-

- i) Addressable fire alarm panels shall be provided in each CER and shall include but not be limited to the following elements:-

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Analog Addressable Fire Detection and Alarm System panels with Master processor module, monitoring modules, supervisory control modules, input/output modules, auxiliary relay modules, network modules and Power supply system (batteries and battery chargers, suitable for providing battery backup of 24 hours (stand by) and 30 minutes (in alarm conditions), etc

All fire alarm panel shall be interconnected with each other & repeater panel and with PLC panels of fire water pump house such that information related to Fire Alarm system can be viewed from any panel.

- ii) Centralized PC based monitoring station along with mini-UPS and one A4 size color laser printer shall be provided for each Central Control Room. It shall serve the purpose of Central PC Station with facility of monitoring information related to all Fire Alarm system and of operating drives of Fire Water pump house and various pump houses.
- iii) One number addressable type repeater annunciation panel in central fire station with power supply system (batteries and battery chargers, suitable for providing battery backup of 24 hours (stand by) and 30 minutes (in alarm conditions), etc
- iv) Software and hardware as required to provide a complete functioning of the system.
- v) Fire alarm panels shall provide contacts to CCTV, Air Conditioning system and ventilation system of engine hall for initiating control functions like shutdown of fans/air conditioning equipment, tripping of transformers, etc. Details for the same shall be finalized during detail engineering.
- vi) Fire detection & protection system shall have the provision for future interconnection with Employer's LAN/WAN preferably from a single point.
- vii) Short term fire proof cable shall be used for inert gas protected areas as follows:
Detector to detector / isolator/interface unit and detector/ interface/ isolator unit to JB.

Detector cables outside the building shall be corrugated steel taped armoured laid through cable trays wherever available and for rest of the areas, cable shall be buried at 600 mm depth with sand filling and brick covering at the top.

Detector cable within the building shall be unarmoured & laid through GI conduits to prevent damage.

Remote manual operation of the deluge valves shall be possible from the respective fire alarm control panel through the keyboard operation of PC monitoring station when the system is selected in remote manual mode.

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Power Supply System

The DC Power Supply system shall consists of the following system(s):-

- i) 24 V DC power supply system for each PLC based control system shall comprise of two sets, each set shall consist of 1x100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1x100% Nickel - Cadmium batteries for one (1) hour duty, 1x100% DC distribution board and 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)—common for both the sets.
- ii) One set of 24 V DC power supply system comprising of 2x100% Chargers and 1x100% batteries for each fire alarm panel and repeater alarm panel with battery backup of 24 hours (standby) and 30 minutes (in alarm conditions).

For detailed specification of power supply system, please refer part B of technical Specification.

g) Fire Extinguishers

- i) Fire extinguishers shall be installed in all the buildings within plant boundary as per TAC requirement.
- ii) The Contractor shall supply the following minimum quantities of fire extinguishers and install the same at various locations. However, the actual quantity shall be as per TAC requirement.

1.	Portable type:	
	Pressurized water type (9 lit. cap.) (IS:15683 operated by CO2 cartridge type)	30 Nos.
	Foam type (9 lit. cap. IS: 15683)	—15 Nos.
	CO2 type (4.5 kg. Cap. IS: 15683)	30 Nos.
	Dry Chemical powder (6 kg. Cap. IS: 15683)	25 Nos.
2.	Mobile type:	
	Foam type (50 lit. cap. IS: 13386)	1 Nos.
	CO2 type (22.5 kg. Cap. IS: 2878)	5 Nos.
	Dry Chemical powder (50 kg. Cap. IS: 10658)	5 Nos.

h) Fire tender and Fire Station Equipment

Fire station building shall be equipped with all the equipment as required for efficient operation of the fire squad. The scope of equipment includes but not limited to the followings:

- i) One number fire water tender, type-B for fire brigade use as per IS:950 with all accessories listed in IS.
- ii) One no. 2000 kg. DCP tender with all accessories as per IS: 10993 and its appendices.
- iii) One no. foam tender with all accessories as per IS: 10460 and its appendices.
- iv) One no. fire jeep with trailer pumps and with all accessories as per IS: 944 and its appendices.

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- v) Four (04) Nos. of fire suits as per relevant IS code.
- vi) Ten (10) Nos. of breathing apparatus as per relevant IS code.
- vii) Two sets of first aid kits as per relevant IS code.
- viii) Two sets of telescopic ladders as per relevant IS code.
- ix) Ten (10) sets of fiber glass blankets as per relevant IS code.
- x) Four (4) nos. multi purpose nozzles.
- xi) One (1) no. portable thermal imaging camera.

For detailed specification of fire tender and fire station equipments, please refer Annexure-III, Chapter M5, Volume-I, Part B of technical Specification.

- j) One (1) number Monorail Electric Hoist of minimum five (5) ton capacity for main fire water pump house.
- k) All pylons required for transformers, etc. shall be anchored to soak pit base slab of individual transformer, paved area outside soak pit, etc. using anchor fasteners of adequate capacity. Subsequent to fixing the pylons, lower part of pylon which would be within filled up gravel portion shall be encased with concrete by Contractor for corrosion protection.

NOTE: Bidder to refer Annexure-II, Chapter M5, Volume-I, Part-B of technical specification for major Technical Data.

13.00.00 AIR CONDITIONING SYSTEM

- a) **General**
Complete Air conditioning system consisting of Packaged air conditioner, Hi-wall split air conditioner /Cassette Air conditioners, air distribution system (ducting, filters, piping, valves, isolation dampers, motorized fire dampers, diffusers, grills, etc.) etc., along with all electrical equipment and instrumentation as required for all the buildings which are in the scope of the bidder, as detailed out in Part-B of technical specification .
- b) **Air-conditioning system for Main Plant Control room.**
Packaged Air conditioners (Ductable type) of suitable capacity with 100 % redundancy shall be provided for Main Plant Control room building.
- c) **Cassette and Hi-wall Air-conditioners**

Suitable capacity with 100 % redundancy for office, meeting/conference rooms, shift in-charge room, various miscellaneous rooms/areas covered under bidder's scope, etc. which require air conditioning.
- d) The capacity (TR) shall be the actual output of the Hi wall /cassette / packaged air conditioners under specified design outdoor and indoor condition. Nominal ratings of Hi wall /cassette / packaged Air conditioners will not be acceptable.
- e) Any additional items required to make the air conditioning system complete.

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- f) For Air conditioning system, the Contractor shall provide all Instrumentation systems, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.
- g) Details related to control system of Air Conditioning system are indicated in , Control & Instrumentation, Scope of Supply & services, Part-A of Technical Specifications.

14.00.00 VENTILATION SYSTEM

a) **General**

Complete Ventilation system consisting of Supply air fans, roof extractors, exhaust air fans, louvers, filters, instrumentation etc., for all the buildings /areas which are in the scope of the bidder, as detailed out in Part-B of technical specification.

b) **Main Plant building and associated areas**

The main machine hall shall be ventilated by a combination of roof extractor fans and supply air fans fitted with pre filter & fine filter.

c) **Switchgear building in transformer area & LT switchgear room**

Switchgear building in transformer area & LT switchgear room shall be ventilated by a combination of back draft dampers and supply air fans fitted with pre filter & fine filter.

- d) **Miscellaneous areas:** All other areas like pump houses, MCC rooms and switchgear rooms, stores, pantry, etc. covered under Bidder's scope shall be ventilated by a combination of supply air fans & roof exhausters fans or supply air fans & exhaust fans or supply air fans & back draft dampers or fresh air in-take louvers & exhaust air fans. For ventilation of battery rooms and oil rooms, flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.

- e) Any additional items required to make the system complete.

- f) For Ventilation system, the Contractor shall provide all Instrumentation systems, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.

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- g) Details related to control system of Ventilation system are indicated in Sub-section IIC, Control & Instrumentation, Scope of Supply & services, Part-A of Technical Specifications.

15.00.00 ELEVATOR, CRANES AND HOISTS ETC.

15.01.00 EOT Cranes

Required numbers of Electric Overhead travelling (EOT) type cranes for various areas/buildings as specified in other sections of this volume & Part-B, Section-VI of Technical Specification.

15.02.00 Monorail Hoists

Required numbers of monorail hoists for handling of various equipment of pump houses, various equipment of Desalination plant, various pumps and motors in pump houses etc. as specified in Part-B, Volume-I, Section-VI of Technical Specification.

Requirement of EOT Cranes and Hoists as mentioned above is only indicative and bidder to provide lifting arrangement in all areas as required.

15.03.00 Passenger Elevators

The Passenger elevators for Common control room/ Utility building shall be as under.

- (i) 01 nos. conventional type elevator having capacity of 10 persons (680 kg.)
- (ii) The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS:14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include but not limited to the following:
 - a) 1 No. fireman's switch for each elevator.
 - b) Machinery supporting Beam.
- (iii) Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection
- (iv) To obtain necessary local administration permits /approvals and make arrangements for inspection and tests required thereby.

15.04.00 Hydraulic Crane , Battery Operated trolley & Fork Lift

Bidder shall supply 1 (one) no. 15 Tons capacity hydraulic crane, 1 (one) no. min. 3 Tons capacity medium size multipurpose battery operated trolley and 1 (one) no. min. 1Ton capacity Fork lift.

Design of Crane, Trolley & Fork Lift shall be in line with relevant standards and codes, details of which shall be finalized during the detail engineering.

16.00.00 CONTROL AND INSTRUMENTATION SYSTEM

16.01.00 GENERAL

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- a) The Contractor shall be responsible for design, material procurement, fabrication, programming, testing, packing, unloading, storage, shipping, installation & commissioning of a complete PLC based control system for the Gas Engines, Common and electrical systems with all related services in accordance with intent and requirements of the specification. The Contractor shall provide all systems, equipment, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer. The Contractor shall provide all material, equipment and services so as to make a totally integrated Instrumentation
- and Control System together with all accessories, auxiliaries and associated equipment ensuring operability, maintainability and reliability. The work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract. The requirements of statutory Authorities (e.g. MOEF, Inspector of Factories, IBR, TAC, CPCB/SPCB/CERC etc. with regard to various plant areas like main plant, Chlorinating Plant, Fire-fighting system, Emission measurements etc.) shall be complied even if not actually spelt out.
- b) The Contractor shall provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. The work shall be consistent with modern Gas Engine based power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract.
- c) The Contractor shall also provide all the instruments along with cables, JB etc. for equipment / drives and services which may not be specifically stated in this specifications but are required for completeness of the Control system shall be furnished by the Contractor and for meeting the intent and requirements of these specifications. All instruments/ equipments etc. shall be suitable for highly corrosive environment prevalent in the coastal area. For coastal areas, all instruments/ equipments shall be provided with durable epoxy/ polyurethane coating for housings and all exposed surfaces of all instruments/ equipments.
- d) The Contractor scope shall include design, manufacture, engineering, inspection & testing at supplier's works, packing, forwarding to site, unloading, erection, testing & commissioning. The following clauses describe the brief scope of supplies. It is intended to provide the brief scope only, any other equipment/system required for ensuring the safe, reliable and trouble free operation of the plant under the present scope of the work shall be provided within the lump sum quoted price of the contract. The detailed technical specifications are stipulated under Part - B, of the specification including all annexure, appendixes etc. However Contractor to ensure the functionality & operability of the complete system in all regimes of operation.
- d) All other special instruments/ equipments for which specifications are not provided in Part-B, of technical specifications shall be provided as on required basis as per OEM Standard & Proven practice. Contractor's offering as per his "standard and proven practice" shall be accepted based on the documentary evidence.

The detailed technical specifications are stipulated under Part - B, Section-VI of the specification as well as in various other Parts of the Technical Specifications.

16.02.00 MEASURING INSTRUMENTS

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16.02.01 Primary instruments like Microprocessor based transmitters employing HART protocol, thermocouples & RTDs along with temperature transmitters, pressure/diff. pressure/temperature/flow transmitter & gauges, flow sensing elements (orifice plates, flow nozzles etc.), Radar type level transmitters, Gas leak detectors, Fuel Gas flowmeter etc. to be provided on as required basis complying the specification requirement specified in Part B.

All the instruments shall be provided to meet the actual system requirements and meeting redundancy and other requirements specified under technical specifications, as per OEM practice, subject to Employer's approval.

16.03.00 CONTROL SYSTEM

The Contractor shall provide PROGRAMMABLE LOGIC CONTROLLER (PLC) based control system for Gas Engines as well as for Common and Electrical System Controls. The Control System shall be able to perform automatic sequential start up, run-up, synchronization, loading, unloading and shutdown operation of Gas Engines in safe and efficient manner under all regimes of operation. This shall include auto operation of various auxiliaries/ sub systems like lube oil system, cooling water system, etc. In case contractor offers DDCMIS in place of PLC based control system, the same shall be acceptable.

Gas Engine shall be provided with a governing system including speed and load controllers with frequency-droop correction for regulating the fuel flow into the engine. The control system shall be designed for operation as detailed under this technical specification. Other controls which are necessary, and as per the Gas Engine supplier's recommendations are also envisaged.

Automatic Startup and Shutdown Sequencing System shall be provided including all required interlocks, sequence logic and modulating control loops for safe and efficient startup/ shutdown of the Gas Engine.

Three number of Operator Work Station (OWS) and A4 size color Laser printer for controlling and monitoring of the Gas Engines and associated system shall be provided and the same shall be located in Central Control Room. Instrumentation and Control System with interlocks, protection and annunciation for the complete system being provided under the contract shall be provided with all required software and hardware to make the system complete and functional.

Additionally, two OWS shall also be provided with capabilities of programming station and historian capability to store at least 30 days of historical data of PLC system (EWS cum OWS).

Depending on the cable distance between Central control room and other sub systems requirement of Remote Input Output (RIO) shall be finalized during detail engineering, in such cases, contractor to provide RIO on as required basis. Contractor shall place RIO cabinets inside RIO rooms with air conditioning environment or else RIO panels shall be provided with panel mounted ACs. RIO rooms, Air conditioning, power supply for RIO cabinets shall be in contractor's scope.

16.04.00 Other Systems

Other Systems like CEMS, AAQMS, UPS power supply, PCP, Instrumentation cables, Optical fibre cables, Junction boxes, Conduits, Cable sub trays, Control valves, Electric Actuators, Master Clock, CCTV, PA system and Walkie Talkie shall be provided on as required basis/ minimum quantity as specified in Part B for complete plant, meeting requirements specified in Part B Chapter III C of specifications.

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16.05.00 CENTRAL CONTROL ROOM

An air conditioned Central Control Room of adequate size housing the PLC based control system panels, Control desk, OWS, UPS, Battery etc. shall be provided by the contractor. The Control room shall be esthetically designed offering a complete view of the engine hall to the operators at all time. Temperature & Humidity of Control room/ RIO room (if any) shall be continuously monitored. Battery shall be located in an air ventilated area inside the Control Room. The final design of the Control Room shall be finalized during detailed engineering.

17.00.00 ELECTRICAL SYSTEMS

The Bidder scope shall include design, engineering, manufacture, type testing, inspection & shop testing at supplier's works, packing, forwarding to site including customs clearance/ port clearance (if required), receipt and unloading, inplant transportation, handling and storage (preservation & conservation of equipment) at site, erection including associated civil and structural works, testing and commissioning of the Electrical equipment/ system and works as indicated in this chapter. The Electrical scope shall be as described briefly in the following clauses but not limited to it.

17.01.00 Generator and Auxiliary System

17.01.01 Generator complete in all respects including stator, rotor, bearings, couplings, terminal pads with palms and all its associated supervisory and instrumentation system.

17.01.02 Complete cooling systems as applicable including the necessary piping and pipe supports, valves, necessary tanks, pumps, motors, heat exchangers, strainers, measuring system along with the control panel.

17.01.03 Complete excitation system (brushless or static type) with exciter, excitation transformer, thyristors, rectifiers and filters, field flashing and field forcing equipment, rotating diodes etc. as applicable along with the DAVR, de-excitation equipment, cables/bus duct and all necessary control, annunciation and monitoring equipment mounted on suitable panels.

17.02.00 MV Busduct

a) Medium Voltage Busduct and Auxiliary equipment

MV busducts shall be provided for Interconnection between Generators, transformers and switchgears as per provisions in relevant portion of technical Specifications.

17.03.00 Transformers

S.No.	Equipment Name	Rating/Parameters	Quantity
1.	POWER TRANSFORMERS / REACTORS / AUXILIARY OIL FILLED TRANSFORMERS		
i)	Generator Transformer	as per SLD & System Requirement	As per SLD and system requirements
ii)	Auxiliary Transformers (including LT Outdoor)	as per SLD & System Requirement	

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S.No.	Equipment Name	Rating/Parameters	Quantity
iii)	INDOOR Transformers (Epoxy cast resin/ resin encapsulated)	as per SLD & System Requirement	
2.	TRANSFORMER MAINTENANCE TESTING & MONITORING EQUIPMENTS	Refer Transformer Sub-Section, Part-B of Technical Specifications	
3.	SPARE OIL	Refer Transformer Sub-Section, Part-B of Technical Specifications	5% of total Volume for all Transformers & Reactor

The preferred standard Transformers ratings shall be as indicated in a typical key single line diagrams Drg. No. 6400-999-POE-J-001 enclosed in Tender drawings.

17.04.00 SWITCHGEAR

17.04.01 33/11kV SWITCHGEAR (MV SWITCHGEARS)

33 kV /11 kV Switchgear boards as required, Busduct / Cable (as applicable), (a typical key single line diagrams for Aux Power Supply (6400-999-POE-J-001 Rev-A) is enclosed). The design and sizing criteria of the Switchboards shall be as detailed at chapter E-9. It is preferable to supply MV Switchgear from a single manufacturer.

33kV Switchboard (each section) shall have two (2) no. of feeder as spare.

Contractor's scope also include the Insulating mat for laying in front of 33/11kV Switchgears in switchgear rooms.

17.04.02 LV SWITCHGEARS AND LV BUSDUCTS

The scope of work includes the following for feeding all the LV Loads of the power plant as required (a typical key single line diagram for Aux Power Supply Drawing No. 6400-999-POE-J-001 enclosed). The design and sizing criteria of the Switchboards shall be as detailed at Chapter E-10. The major LT Switchgear shall include the following:

415 Volt Switchgears

415 Volt Motor Control Centers

415 Volt AC Distribution Boards

220 V DC/110 V DC/48 V DC Distribution Boards

415 Volt AC Fuse Boards

220 Volt DC/110 V DC Fuse Boards

Local Motor Starters for Ventillation fans, Local Push Button Stations for all motors except for ventilation fans, Telescopic Trolley for Breaker Handling, Welding / Lighting Transformers

LV Bus ducts

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All switchgear, Motor Control Centers (MCCs) & AC/DC distribution boards, etc. shall have at least 20% or minimum two (whichever is higher) fully equipped switch-fuse modules of each rating as spares, uniformly distributed over different vertical sections. In addition, all switchgears, MCCs, AC/DC boards, etc., shall have as spares at least twenty (20%) per cent of starter modules/MCCB module or at least one module (whichever is higher) of each of each rating.

Contractor's scope also include the Insulating mat for laying in front of LT Switchgears in switchgear rooms.

It is preferable to supply LT Switchgears and LT Busducts from one manufacturer.

17.05.00 DC System

Battery and Battery Charger

Lead acid plant type/ Nickel Cadmium batteries and Float cum boost chargers for plant and all other areas in the scope of the contractor, as per system requirement.

The DC systems (Battery and Charger) shall be supplied to cater to various DC loads in the plant. The design and sizing criteria shall be as detailed out in the chapter E-1, Part-B of Technical specifications.

One set of variable metallic resistor and shunt for each battery rating & location suitable for carrying out the discharge test on the batteries under Contractor's scope shall also be supplied.

It is preferable to supply dc system from one manufacturers.

17.06.00 MOTORS

Motors along with couplings and coupling guards for all rotating auxiliaries covered under this package.

17.07.00 Cabling

Following shall be in the scope of the contractor for the complete plant, building, equipment and switchyard system etc. including interplant areas.

- (a.) Laying of HT power, LT power and control cables.
- (b.) Cable trays, fittings and their accessories, along with support system.
- (c.) Cable glands and lugs.
- (d.) Straight-through jointing kits for HT XLPE power cable, LT power and control cables.
- (e.) Cable termination kits for HT XLPE power cables.
- (f.) Welding receptacles.
- (g.) Trefoil cable clamps.
- (h.) Junction boxes.
- (i.) Galvanised steel pipes/ HDPE/ Hume pipes/ PVC pipes
- (j.) Miscellaneous items like M.S. sections etc. as required

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- (k.) Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc.
- (l.) In addition to other drawings, Contractor shall also prepare complete equipment layout drawings, lighting layout drawings including cable tray layout, routing, Power and control cable schedules etc.
- (m.) Control interconnection charts shall also be prepared by bidder.

17.08.00 CABLES

17.08.01 HT Power Cables

HT power cables as indicated in typical key single line diagrams for Aux Power Supply (Drg. No 6400-999-POE-J-001) and evacuation system along with necessary termination, lugs and glands as required for the complete plant.

17.08.02 LT Power and Control Cables

LT Power and Control cables as required for the complete plant, building, equipment etc.

17.09.00 Earthing and Lightning Protection

Below ground and above ground earthing mat / Grounding and lightning protection for the complete plant is in the bidder's scope.

17.10.00 Station Lighting

Station lighting system for the plant, buildings and equipment in the bidder's scope. Lighting fixtures complete with lamps & accessories, LED lighting fixture complete with driver circuit & accessories Lighting Panels, Receptacles, Switch boxes. Conduits. Lighting Wires, Ceiling fans with regulators, lighting poles. Lighting masts, Earth wires and rods, Junction boxes, Battery operated automatic self-contained lighting fixture, Maintenance ladders as required are included in the bidder's scope.

Mandatory spare parts and maintenance equipment as required.

LED type lighting fixtures shall be provided for Lighting Mast.

17.11.00 DG SET

1 (one) No. for Diesel Generator sets along with acoustic enclosure of stationary type suitable for outdoor installation to be provided. Mandatory spare parts and maintenance equipment as required.

17.12.00 Control Philosophy for plant Electrical System

Control of Electrical System shall be provided from DCS/PLC with suitable ECD (Electrical Control Desk) and/or Soft HMI. The details of the same are specified in relevant sections of Control and Instrumentation.

17.13.00 Protection and Metering

Necessary Protection and metering system as detailed in relevant portion of technical specification shall be provided.

17.14.00 CONSTRUCTION POWER

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To meet the construction power requirement of the project, DG sets shall be employed. The Bidder shall extend supply from these to meet the construction power requirements at the various locations through suitably rated isolation transformers along with LT distribution boards as per requirement. LT packaged substation along with isolation transformers may also be used for the purpose.

Supply, erection, testing and commissioning of overhead lines ring mains, single pole /double pole/ four pole structures with switches, fuse, lightening arrestors, LT transformers, 415V switchboards, power and control cables, DC Systems etc. as required for meeting the construction power requirements, shall be in the bidder's scope. All necessary statutory requirements for charging construction power bidder's network shall be in the bidder's scope. The bidder shall also provide power for meeting the Employer's office/miscellaneous power requirements. Construction power supply network, within the plant, is a temporary arrangement which shall be used during the project construction phase. To meet this requirement, the equipments may be arranged by Bidder either by shifting their existing equipments at other installation or by fresh procurement, which may be taken back after commissioning of the project.

All temporary wiring must comply with local regulations and will be subject to Employer's inspection and approval before connection to supply. All necessary spares, consumables, Fuel etc. shall be under Bidder's scope.

17.15.00 PAINTING FOR ELECTRICAL EQUIPMENT

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.

17.16.00 TYPE TEST

Contractor shall meet the requirements of type tests on electrical equipments as stipulated in relevant chapters of technical specifications.

18.00.00 SUPPLIES FOR PLANT SERVICES

18.01.00 Bidder's Scope of Supply includes Supply of necessary material for the Plant services and Accessories of various equipment and systems as follows.

18.02.00 Complete plant drain system together with all necessary piping, valves, fittings, supports, pumps and drives etc., so as to render the system complete.

18.03.00 All the first fills of consumables such as greases, oil, lubricants, servo fluids / control fluids, chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

19.00.00 CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

19.01.00 The scope of civil, structural and architectural works shall include survey, site clearance including cutting of trees and site levelling by filling with borrow earth/ grading, geotechnical investigations, preparation of design, documents and drawings and getting approval of the same from the Employer and construction of all civil, structural and architectural works including supply of materials for all buildings, equipments and facilities for the project. The

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nature of work generally involves survey, site clearance, levelling, geo-technical investigation earthwork in excavation, sheet piling, de-watering, backfilling around completed structures, plinth filling, disposal of surplus earth, concreting including reinforcement and form work, masonry work, plastering, painting, uninsulated / sandwiched insulated metal wall cladding, roofing including permanent steel decking, flooring, false ceiling, under deck insulation, false flooring, acid and alkali resistant lining, fabrication and erection of all structural steel and miscellaneous steel (i.e. steel staircase, cable supports, pipe supports, ladders, walkways, railing, chequered plate/grating floors, inserts, anchor bolts etc. including painting of structures) paving, gravel filling, providing pre-cast covers, trestles, expansion joints, rain water pipes, water supply and sanitary fittings, sewage lines including sewage treatment plant, fire fighting system, effluent treatment, gates/valves, damp proofing, roof water proofing, anti-weed treatment, roads, drainage, final grading and site clearance before handing over and any other items of work required for completion of all systems under the scope of work complete.

- 19.02.00 The scope of Bidder for civil, structural and architectural works as defined above shall include but not be limited to the following buildings/ areas/ systems along with their foundations, super structures and finishes complete.
- 19.02.01 Site levelling by cutting & filing and filling with borrow earth including protection work on sloped portion after completion of all compaction work. Providing RCC retaining wall (sea wall) for protection against high tides. RCC boundary wall, gate complex, watch towers of the plant.
- 19.02.02 Geo-technical Investigations.
- 19.02.03 Foundation including machine foundations as per requirement.
- 19.02.04 Engine Buildings.
- 19.02.05 Facilities & Common Control Building.
- 19.02.06 Switch gear room.
- 19.02.07 Foundations for Power house & its auxiliaries.
- 19.02.08 Civil works for transformer yard, including transformer foundations, oil pits, cable ducts, cable trenches with covers, fire protection walls, concrete paving, roads, drains, gravel fill, oil drainage to oil water separation pit, oil recovery and drainage of separated water, fencing etc. complete.
- 19.02.09 Construction Fire Water pump house etc. complete including making connection to puddle pipes.
- 19.02.10 Plant effluent treatment and disposal system. Treated effluents shall be conveyed independently to central monitoring basin (CMB) to be constructed by the bidder. From CMB, the effluent to be discharged as directed by NVVN.
- 19.02.11 Fire Detection & Protection System alongwith buildings / facilities required therein.
- 19.02.12 Complete Rigid type road network and connecting these to existing roads. Scope also includes approaches to all facilities/ buildings (including Employer's building), including crossings, culverts, if any.
- 19.02.13 All associated works for complete plant area storm water drainage system and connecting the same to the final discharge point, diversion of existing drains etc. to suit the site conditions.

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- 19.02.14 Complete sewage collection including sewage treatment plant and disposal system of the plant and its conveyance either by pumping or by gravity to the sewage treatment plant.
- 19.02.15 Fire station and electrical switchgear buildings
- 19.02.16 O&M stores, Utility building, maintenance bay.
- 19.02.17 Cable/ LP piping overhead supporting structural steel trestles complete for entire plant area. Work also includes civil works required for fire fighting pipelines etc. complete.
- 19.02.18 Civil works associated with pipe trestle foundations, low pressure (LP) pipe pedestals along with insert plates, all low pressure (LP) pipe trenches including insert plates, cross pipe support beams, etc.
- 19.02.19 Providing earthing mat for the plant, switchyard and all other systems.
- 19.02.20 Plinth protection and roof water drains around buildings, concrete paving in plant.
- 19.02.21 Civil works for 1 No. covered car parks with having facility to park 5 cars.
- 19.02.22 Supply of cement, reinforcement steel and structural steel and other required materials.
- 19.02.23 Implementation of Roof Top Rain water harvesting in plant. Min. 300 m³ size Rain water harvesting tank to be provided within the plant.
- 19.02.24 Acoustic treatment of the Engine Hall to control the noise within permissible limits.
- 19.02.25 Civil and structural work for makeup water, water treatment plant, RO, storage tank, pumps, sheds for pumps and all work related to water system.
- 19.02.26 Any other civil structural and architectural works not specified above but necessary to render the project complete as per requirements in clause 1.00.00 of this section are also included in Bidder's scope unless specifically brought out under exclusions.

20.00.00 ROOFTOP SOLAR

- 20.01.00 The Solar Photo Voltaic (PV) installation on Rooftop of various buildings of the Power Plant shall be carried out preferably on shadow free area in such a way that the generation is maximized on each building suitable for installation of Solar PV power plants.

The bidder has to install the solar PV rooftop system on the buildings identified in this package on the basis of 15 square metre area(shadow free) per kwp and the bidder shall also consider utilizing all the rooftops(Buildings) for installing solar PV project.
- 20.02.00 Determination of optimal grid connected roof-top Solar PV power plants capacity on the buildings of the power plant.
- 20.03.00 Complete design, engineering, manufacture, inspection, supply, transportation, storage, insurance, civil work, erection, testing, commissioning and three year O&M of the grid connected rooftop Solar PV plants including all auxiliaries.

21.00.00 SCOPE OF SERVICES

- 21.01.00 Bidder's Scope of Services in respect of the equipment/ systems specified shall include all services required for Planning, Design, Engineering, Manufacture / Fabrication, Assembly,

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Pre-shipment Testing at manufacturer's works, Packing for Transportation, Transportation, Handling, Delivery at Plant Site, Storage, Installation, Interconnection with related plant and equipment, Commissioning, Initial Operation, and Conductance of Acceptance Tests.

21.02.00 In addition to above, the Scope includes all other services necessary for meeting the intent and requirements of the specification within his quoted price. These shall include, but shall not be limited to the following services for all equipment / systems as per the specification.

21.03.00 Engineering Services and Engineering Documentation

21.03.01 Scope includes System Design/ Engineering for all equipment and systems to ensure that the intent and requirements of the specification are fully met. The plant shall be engineered and designed strictly in accordance with the specification requirement.

21.03.02 Scope includes preparation, submission and obtaining Employer's approval for all Engineering Drawings/ Documents as detailed in 'General Technical Requirements' (Volume VI, Part A) and other sections/ subsections of Part B of Technical Specification. Drawings / documents mentioned above shall be prepared by the Contractor and submitted to the Employer as per schedule to be finalised before the award of this contract. Further, all drawings and documents pertaining to Gas engines and their associated auxiliaries shall be vetted by the qualified Gas engine manufacturer for this project before submitting to the Employer for review and approval.

21.03.03 Engineering work shall be performed based on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environment. Employer shall have the right to review and approve the engineering work by himself or herself and/ or through consultant and ask for any clarifications and changes/ modifications to the work performed by the Contractor.

21.03.04 In course of review of Design Memorandums and Detailed Engineering, it may be essential in the opinion of Employer to obtain certain classified data for review purposes only. The Contractor shall furnish such data to Employer, if required.

21.03.05 Technical Co-Ordination Meetings

Scope includes Participation of Contractor's senior personnel and experts as well as major sub-vendors for this package in Technical Coordination Meetings (to be held at EOC NOIDA, Vendor works, Plant site or mutually agreed venue) and other Meetings for discussions on technical issues as required by the Employer.

21.04.00 Type Test Requirements

Bidder's Scope includes conductance of Type Tests for Mechanical, Electrical and C&I Equipment as detailed in respective Volumes of Part B, Section VI.

21.05.00 Packaging, Transportation and Insurance (Ocean & Inland), Dock Clearance

Scope includes receiving of material/ equipment at site, unloading and proper storage. Proper storage of all mandatory spares and other equipments till handing over to the Employer shall also be under the scope of the Bidder.

21.06.00 Training of Employer's Personnel

Scope of training shall include training of Employer's personnel covering entire scope for the package. This shall cover all disciplines viz. Mechanical, Electrical, C&I, QA etc.

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Training shall include all the areas related to plant like Design familiarization and training on product design features of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, equipment maintenance, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.

Total duration of the training shall be of 5 (five) man months. The break-up of the training period shall be as following-

- i. 1 (One) Man month – At Engine manufacturers works/factory
- ii. 4 (four) Man months - Comprehensive training program consisting of classroom and plant visit of similar running plant for Employer's personnel for safe and efficient operation of the plant addressing the erection, commissioning, operation and maintenance aspects of the plant.

Accommodation with lodging and boarding and local conveyance at the place of training shall be provided to the Employer's personnel free of cost. Cost of journey to and from the place of training shall be borne by the Employer.

Details of the training shall be finalized during detail engineering of the project.

Note : For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person

21.07.00	Erection, Pre-commissioning, Commissioning, and Initial Operation
21.07.01	Scope includes complete services for construction, erection, pre-commissioning and commissioning for all specified equipment/ systems. Manpower, equipment, material, consumables, chemicals, instruments and information for above shall be provided by the Contractor.
21.07.02	Pre-commissioning, Commissioning, and Initial Operation shall be in accordance with the specification requirements indicated in 'General Technical Requirements' (Volume – VI of Part A) and Part B of Technical Specifications. Materials and services required for Pre-commissioning, Commissioning, and Initial Operation shall be in the Contractor's Scope.
21.08.00	Start-up of Power Plant
	(i) Bidder's scope in respect of each Genset Module includes startup following completion of pre-commissioning and commissioning activities. The start-up shall include synchronization and up to base load operation of Genset units. Start-up activity shall also include proving/ establishing all the systems/ automatic controls and protections of the complete Genset modules and associated support systems.
	(ii) Separate start-up reports for all equipments shall be completed before the start of the respective "Initial Operation" of the Genset modules.
	(iii) The time between first start-up and start of 'Initial Operation' shall be considered as a part of the erection and installation period. Bidder's scope includes all commissioning/ operation manpower requirement during the intervening period of Start-up and Initial Operation.

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21.09.00 **Acceptance Tests**

- 21.09.01 The Scope includes carrying out Acceptance Tests at Site for establishing the specified Performance and Functional Guarantees for acceptance by the Employer. Acceptance tests shall be carried out in accordance with the specification provisions of 'Guarantees and Performance Testing' (Volume V, Part A), 'General Technical Requirements' (Volume – VI of Part A) and requirements specified in Part B.
- 21.09.02 The Contractor shall be responsible for making all necessary arrangements required for conductance of specified tests and accordingly the cost associated with the specified tests shall be included in the bid price. Contractor shall provide permanent arrangements in various equipment/systems for conductance of Performance and Guarantee tests by the Owner periodically. Employer's/Client's responsibility shall be limited to ensure power evacuation and arranging fuel.

22.00.00 **CONSTRUCTION FACILITIES**

22.01.00 Bidder's Scope of Work of for the construction facilities of the project is as follows:

- (i) **Site Development** - The bidder shall do all works related to site/forest clearance.
 - (ii) **Drinking Water** -. Bidder shall arrange and make own arrangements for drinking water.
 - (iv) **Construction water** - Water for construction purposes shall be arranged by the bidder. He shall make his own arrangement for drawl, pumping, storage and distribution etc. The drawal scheme, arrangement shall be subject to approval of NVVN. Bidder may discuss his drawl scheme / arrangement during his site visit before submitting his bid. Bidder shall exercise full restraint that the water drawn is minimum and not wasted. Quality of construction water should be such that it shall meet the requirement for construction purposes.
- No water shall be made available by NVVN for water supply to bidder's staff colony / labour camps. Bidder/Contactor shall arrange necessary accommodation bidder's staff & labour.
- (vi) **Construction office and other facilities** – The Contractor shall make his own construction office, construction store (open/ covered), fencing and construction workshop and material/ field testing laboratory etc. as required.
 - (vii) All necessary fire fighting devices, equipments, fire tenders and extinguishers etc. required during the project execution stage shall be arranged by the Bidder.

22.02.00 Bidder's Scope includes lifting devices for handling, erection and maintenance of all the equipment and systems during construction stage.

23.00.00 **SPARES**

23.01.00 Following Spares are included in the scope of supply as per the applicable provisions:

- (i) Mandatory Spares
- (ii) Recommended Spares
- (iii) Start-up Spares / Commissioning Spares

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23.02.00 **Mandatory Spares**

- (a) The list of mandatory spares considered essential by the Employer is indicated in this chapter/volume at Annexures – IA, IB, IC & ID. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms and Price Schedules. Whenever the quantity is mentioned in "sets" it pertains to the requirement for one no. of Engine/Equipment wherever the same has not been detailed in the specification. The bidder has to give the item details and prices of each item
- (b) The Employer reserves the right to buy any or all the mandatory spares parts.
- (c) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.
- (d) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.
- (e) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- (f) Supplied mandatory spares shall be under the ownership of client/owner and same shall not be taken into account by the contractor for the scope of O&M contract.
- (g) Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.

23.03.00 **Recommended Spares**

- (a) In addition to the spare parts mentioned above, the contractor shall also provide a list of recommended spares for 03 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Form and Price Schedules. This list shall take into consideration the mandatory spares specified in this Part-A and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares.
- (b) Price of recommended spares will not be used for evaluation of the bids. The price of these spars will remain valid upto 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.
- (c) This list of recommended spares shall be applicable after the end of O&M contract period. During O&M contract period bidder to arrange all spares etc. at their own cost.

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23.04.00 **Start-up & Commissioning Spares**

Start-up and commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the plant is handed over to the employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.

Bidder shall include in its scope of supply all the necessary Start up & Commissioning spares and indicate these in the relevant schedules of the bid form.

23.05.00 The Contractor shall indicate the service expectancy period for the spares parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.

23.06.00 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.

23.07.00 All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.

23.08.00 The contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalise order for recommended spares.

23.09.00 Each spares part shall be clearly marked or labelled on the outside of the packing with its description. When more than one spares part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

23.10.00 All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.

23.11.00 The contractor will provide the Employer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.

23.12.00 The Contractor shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.

23.13.00 In addition to the recommended spares listed by the contractor, if the employer further

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identifies certain particular items of spares, the contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.

23.14.00 The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the contract. The Contractor shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, he shall give the Employer atleast 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his sub contractors, Contractor will provide the Employers, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.

23.15.00 Material Codification

The bidder to provide datasheets/ assembly drawings of the manufacturer/ any other relevant document showing Bill of Material(s), Make, Model Number, Part Number etc. through which mandatory spares to be supplied can be uniquely identified. This would facilitate the Employer to assign a unique code to each of the mandatory spare as brought out in GCC. The bidder shall extend all necessary assistance in this regard.

23.16.00 In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the lists of mandatory spares.

23.17.00 Interchangeability and Packings:

All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be preset and/or preprogrammed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre setting/pre programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

23.18.00 Identification:

Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description

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of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

- 23.19.00 Wherever the quantity is given only in percentage, the spare quantity shall be distributed into various ranges/size/rating/type (as the case may be) in the same proportion of the main population. The percentage shall be taken for the full population of the plant, unless otherwise mentioned. For the quantities coming less than 1, shall be treated as 1 only.

24.00.00 TOOLS & TACKLES

The Contractor shall supply within this Contract all necessary maintenance and inspection tools including special tools & tackles required for the disassembly, assembly, maintenance inclusive but not limited to, alignment tools for all rotating equipment, rotor removal equipment, torque wrenches capable of meeting all torque tightening requirements.

Tools shall be of a suitable brand, new and unused and shall be stored in the correct manner and at appropriate locations.

All Precision and Special Tools shall be required to be accompanied with a Certified Calibration document for twelve months.

A list of tools to be supplied has been included in Annexure-II of this volume. Further, the bidder shall furnish a list of tools & MC equipment with the Bid documents to the Employer, which shall be discussed and finalized during post bid discussions. All tools not listed in the inventory list and found to be necessary for maintenance of the works shall be deemed to be included in the Contract price.

25.00.00 OPERTAION & MAINTENANCE/INSPECTION OF PLANT

Scope includes services and materials required for operation & maintenance/ inspections works (both scheduled and forced) from commissioning until the completion of O&M contract period.

Operation & Maintenance upto start of O&M contract shall be part of the Main contract. Subsequently after the start of O&M contract O&M charges shall be paid as per relevant provisions of the O&M contract.

O&M contract shall start after take over of the plant, post successful completion of initial/trial operations & Performance guarantee tests including Demonstration tests (whichever occurs later) and shall continue for a period of 03 years. Bidder to ensure minimum 90% annual availability of plant during O&M contract period. During the O&M contract period, owner/client shall be only responsible for the supply of fuels within plant premises. Detail scope of works/services for comprehensive operation and maintenance are as per specifications specified in Part-B of Technical specification.

26.00.00 TERMINAL POINTS

(i)	Fuel	:	Tap-off from gas supplier within plant premises. Exact location of tap-off point shall be informed during detailed Engineering.
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			Bidder to connect gas supply line with incoming gas lines inside the plant boundary at terminal point of gas.
(ii)	Plant Effluent	:	Effluents discharge from disposal pumps to the Sea.
(iii)	Electrical	:	(a) Bidder scope is limited upto evacuation switchyard located at power station. Four (4) nos of 33 kV outgoing cable feeders with appropriate metering are envisaged for the same, as indicated in SLD.

27.00.00 EXCLUSIONS

- (i) Power Evacuation system beyond Terminal point as indicated in SLD.
- (ii) RLNG supply.

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ANNEXURE-IA

LIST OF MANDATORY SPARES: MECHANICAL

Gas Engine and Auxiliaries:

Sl. No.	Item Description	Quantity
Engine Block, Bearings, Oil Sump & Covers		
1.	Camshaft Bearing Bush	1 set
2.	Cylinder head screw	1 set
3.	Cylinder liner	1 set
4.	Antipolishing Ring	2 sets
5.	Sealing Set	2 sets
6.	Thrust Bearing Kit	2 sets
7.	Main Bearing Kit	4 sets
8.	Sealing kit for Covers & End Covers	2 sets
Connecting Rod & Piston		
9.	Big End Bearing kit	2 sets
10.	Piston	1 set
11.	Piston Ring set	1 set
12.	Small End Bearings	1 set
13.	Connecting Rod Screws	1 set
14.	Shims	2 sets
15.	Connecting Rod (Lower part)	1 set
16.	Connecting Rod (Upper part)	1 set
17.	Securing Ring	2 sets
18.	Gudgeon Pin	2 sets
Cylinder Head with Valves		
19.	Cylinder Head	1 set
20.	Starting valve	4 nos.
21.	Inlet valve (complete)	4 nos.
22.	Sealing set for Cylinder head replacement	4 nos.
23.	Seat ring for inlet valve	4 nos.
24.	Seat ring for outlet valve	8 nos.
25.	Sealing set for cylinder head overhaul	4 nos.
26.	Exhaust Valve (complete)	8 nos.
Valve Mechanism & Camshaft		
27.	Intermediate Gear	1 set.
28.	Intermediate Gear Bearing	2 sets
29.	Camshaft piece	2 nos.
30.	Push Rod	2 sets
31.	Protecting pipes	2 sets

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32.	Valve tappet	2 sets
33.	Gear	2 sets
34.	Guide pin	2 sets
35.	Screw	2 sets
Turbocharger, charge Air Cooler & Waste Gates		
36.	Charge Air Cooler	2 sets
3.7	Turbocharger Bearings	4 set
38.	Turbocharger Thrust collar	2 nos.
39.	Turbine Inlet casings	2 nos.
40.	Turbocharger Nozzle Ring	2 nos.
41.	Turbocharger Shroud Ring	2 nos.
42.	Turbine outlet Casings	2 nos.
43.	Turbocharger Rotor & Rotating parts	2 nos.
Ignition Equipment & Gas Manifold		
44.	spark plug	20 nos.
45.	Pre combustion chamber valve	10 nos.
46.	Ignition module	5 nos.
47.	Connection piece/pipes (All types)	2 nos. each type
48.	Ignition cable	10 nos.
49.	Not used	
50.	Main Gas admission valves	2 nos.
Lubricating oil system		
51.	Pump Sealing Set	4 sets
52.	Fuel Feed pipes	4 nos.
53.	Lube oil pump Bearings	1 set each type
54.	Lube Oil service Kit	2 nos.
55.	Lube Oil Thermostat element	2 nos.
56.	Lube Oil Thermostatic element set	10 nos.
57.	Lube Oil filter Candles	5 sets
58.	Lube oil pump Driving Gear	2 nos.
59.	Pre Lube Oil pump gear	2 nos.
Governor		
60.	Governor Drive Bearing	2 sets
Cooling water System		

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61.	LT water pump	2 nos.
62.	HT water pump	2 nos.
63.	Driving gear (All types)	1 no. (each type)
64.	NRV for circulating pump	2 nos.
Exhaust System		
65.	Positioner	2 nos.
66.	Bellows (All types)	2 nos. each type
67.	Multiduct service Kit	2 nos.
Automation & Engine Control		
68.	Knock Sensor	4 nos.
69.	Temperature Sensor (All types)	2 nos. each type
70.	Control Unit CCM	2 nos.
71.	Electronic Unit IOM	4 nos.
72.	Control Unit	2 nos.
73.	Engine Safety module	2 nos.
74.	Pressure Transducer	4 nos.
75.	Pressure Sensor (All types)	2 nos. each type
76.	I/P Convertor	2 nos.
77.	Speed Pick-Up (All types)	2 nos. each type
78.	Speed sensor	2 nos. each type
79.	Limit Switch (All types)	2 nos. each type
Starting Air System		
80.	Starting Air Master Valves of each drive type	2 nos. each type
81.	Start Blocking Valve	2 nos.
82.	Flame Arrestor	2 sets
Other spares		
83.	O ring (All types)	1 no. of each type
84.	Sealing sets (All other types not mentioned above)	2 nos. each type
85.	Butterfly valves (All types)	2 nos. each type
86.	Filter cartridge (All types other than Lube Oil filter)	1 no.) of a particular type and size of filter.
87.	Bellows (All types)	2 sets

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WATER SYSTEM:

A). Horizontal Centrifugal Pumps (Each type /model)

Sl. No	Name of Items	Unit	QTY
1.	Impeller with nuts & other accessories	Set	1
2.	Wearing rings (Impeller & Casing ; as applicable)	Set	2
3.	Shaft	Set	1
4.	Shaft Sleeves	Set	2
5.	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6.	Pump bearings	Set	1
7.	Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one pump			

B). Vertical Pumps (Each type /model) - If applicable

Sl. No	Name of Items	Quantity
1.	Suction Bell / Impeller guide piece	1 Number each
2.	Bowl assembly	1 set
3.	Impeller with nuts and other accessories	1 number
4.	Impeller Shaft with fasteners	1 Set
5.	Shaft Sleeves	2 Sets
6.	Line Shafts & Head Shafts	1 Set
7.	All Gaskets , O-rings	2 Set
8.	Wearing rings – Impeller (if applicable)	1 Set
9.	Wearing Rings – Casing (if applicable)	1 Set
10.	Line, Head and Impeller Shaft bearings	2 Sets
11.	Thrust bearings (of pump & drive assembly)	1 Set
12.	Shaft couplings with all fasteners	1 Set
13.	Pump & Drive Coupling with all fasteners & coupling Guards	1 Set
14.	Gland Assembly / Mechanical seal as applicable	2 Sets
15.	Gland packing as applicable	3 Sets
16.	Thrust brg. collar if applicable	1 Set
17.	Bearing housing	1 Set

C). SWRO (Membranes)

Sl. No	Name of Items	Unit	QTY
1.	RO Membranes	LOT	20% of total installed membranes in all the two streams / trains or 2 Nos whichever is higher

D). High Pressure Pumps (RO Plant)

Sl. No	Name of Items	Unit	QTY
1.	Impeller with nuts & other accessories	Set	1
2.	Wearing rings (Impeller & Casing ; as applicable)	Set	2
3.	Shaft	Set	1

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4.	Shaft Sleeves	Set	2
5.	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6.	Pump bearings	Set	1
7.	Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one Pump			

E). Energy Recovery (ERU) Units – If applicable

Sl. No	Name of Items	Unit	QTY
1.	PX Exchangers	LOT	100 % of PX units installed for one SWRO train/stream
2.	Upstream & Downstream isolation valves	LOT	10% of Valves installed for one SWRO train/stream
3.	PX Booster Pumps		
	i) Impeller with nuts & other accessories	Set	2
	ii) Wearing rings (Impeller & Casing ; as applicable)	Set	4
	iii) Shaft	Set	2
	iv) Shaft Sleeves	Set	4
	v) Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
	vi) Pump bearings	Set	1
	vii) Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one Turbo Charger / PX pump as the case may be			

F). Chemical Cleaning System (SWRO Plant)

Sl. No	Name of Items	Unit	QTY
1.	Mixer (Agitator) of Chemical Tanks	NO	1
2.	Chemical Cleaning Pump & Motor	NO	1
3.	Cartridge Filter Elements	Set	1

G). Flushing Cleaning System (SWRO Plant)

Sl. No	Name of Items	Unit	QTY
1.	Flushing Pump & motor	NO	1

H). Pre- Filtration

(i) Cartridge Filtration Units (For SWRO Plant) (If applicable)

Sl. No	Name of Items	Unit	QTY
1.	Cartridge Filters Elements	LOT	30% of total installed membranes in all the three streams/trains

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(ii) Pressure Sand (PSF) Filters (If applicable)

Sl. No	Name of Items	Unit	QTY
1.	Inlet Water Distributor Assembly	Set	2
2.	Strainers / Nozzles of Under drain Collector OR Header Lateral Collector (whichever is applicable)	Set	1
3.	Filter Media	LOT	One full charge for one filter + 10%
Note : One set consists of quantity required for complete replacement for one filter			

(iii) Dual Media (DMF) Filters-If applicable

Sl. No	Name of Items	Unit	QTY
1.	Inlet Water Distributor Assembly	Set	2
2.	Strainers / Nozzles of Under drain Collector OR Header Lateral Collector (whichever is applicable)	Set	1
3.	Filter Media	LOT	One full charge for one filter + 10%
Note : One set consists of quantity required for complete replacement for one filter			

(iv) Filter Backwash Water Pumps- If applicable

Sl. No	Name of Items	Unit	QTY
1.	Impeller with nuts & other accessories	Set	1
2.	Wearing rings (Impeller & Casing ; as applicable)	Set	2
3.	Shaft	Set	1
4.	Shaft Sleeves	Set	2
5.	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6.	Pump bearings	Set	1
7.	Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one pump			

(v) Filter Air Blowers (Air scouring of PSF & DMF)- If applicable

Sl. No	Name of Items	Unit	QTY
1.	Impeller with nuts & other accessories	Set	1
2.	Shaft	Set	1
3.	Bearings of Blowers	Set	1
4.	Suction filter Assembly	Set	1
5.	V Belts(if applicable)	Set	1

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Note : One set consists of quantity required for complete replacement for one blower of each type / rating/ size

(vi) Filter Feed Pumps-If applicable

Sl. No	Name of Items	Unit	QTY
1.	Impeller with nuts & other accessories	Set	1
2.	Wearing rings (Impeller & Casing ; as applicable)	Set	2
3.	Shaft	Set	1
4.	Shaft Sleeves	Set	2
5.	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6.	Pump bearings	Set	1
7.	Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one Pump			

I) UF SYSTEM

I-1) Ultra-filtration (UF) Plant – Membranes			
Sl. No.	Name of Items	Unit	QTY
1)	UF Membranes	LOT	10% of total installed membranes in proposed streams/trains

I- 2) UF Feed Pumps (UF Plant)			
Sl. No.	Name of Items	Unit	QTY
1)	UF feed pump	Set	1

I- 3) UF Feed Pumps (SWRO Plant)			
1)	Impeller with nuts & other accessories	Set	2
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	4
3)	Shaft	Set	2
4)	Shaft Sleeves	Set	4
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6)	Pump bearings	Set	1
7)	Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one Pump			

I- 4) UF Permeate Transfer Pumps (UF Plant)

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1)	Impeller with nuts & other accessories	Set	2
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	4
3)	Shaft	Set	2
4)	Shaft Sleeves	Set	4
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6)	Pump bearings	Set	1
7)	Mechanical Seal	Set	1
Note : One set consists of quantity required for complete replacement for one Pump			

J). Valves (except Control Valves) – For Sizes 80 mm NB and less

Sl. No	Name of Items	Unit	QTY
1.	Valves of all types	LOT	2 numbers of each type / size /material of construction

K). Valves (except Control Valves) – For Sizes above 80 mm NB

Sl. No	Name of Items	Unit	QTY
1.	Sluice Valves / Gate Valves		
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts	LOT	1 set of each type / size /material of construction
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction
2.	Butterfly Valves		
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings	LOT	1 set of each type / size /material of construction
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction
3.	Diaphragm Valves		
	a) Diaphragms	No	2 each type / size /material of construction
	b) Seats, Rings, Gaskets, Gland, Packing & Nuts & Bush	LOT	1 set of each type / size /material of construction
	c) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction
4.	Globe Valves		
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings	LOT	1 set of each type / size /material of construction
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction

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			construction
5.	Plug Valves		
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Plug	LOT	1 set of each type / size /material of construction
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction
6.	Check Valves of all types		
	a) Seats, Rings, Disc/ Door/ Flap, Hinge& Door pins, Gland, Packing & Nuts, Gaskets, Ball (for lift type)	LOT	1 set of each type / size /material of construction
	b) Complete Valve	LOT	1 number of each type / size /material of construction
7.	Air Release Valves		
	a) Seats, Rings, Gaskets	LOT	1 set of each type / size /material of construction
	b) Complete Valve	LOT	1 number of each type / size /material of construction
Note : One set consists of quantity required for complete replacement for one valve			

L). ELECTRICALLY OPERATED HOISTS

Sl. No	Name of Items	Unit	QTY
1.	Bearings	Set	1
2.	Rope guide	Set	1
3.	Brake lining	Set	1
4.	Wire rope	Set	1
Note : One set consists of quantity required for complete replacement for one hoist of each type & capacity			

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

PLANT UTILITIES:

1.00.00	Compressed Air System:	
1.01.00	Oil free Screw Air Compressor (As applicable)	
1.01.01	H. P. Stage Complete HP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.	1 Set of each type/rating
1.01.02	L. P. Stage Complete LP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.	1 Set of each type/rating
1.01.03	Motor Bearings	2 Sets
1.01.04	LP stage Gear and Pinion	1 Set
1.01.05	HP stage Gear and Pinion	1 Set
1.01.06	Air Intake Filter Element With Gaskets	4 Sets
1.01.07	Oil Filter Element With Gaskets & Seals	4 Sets
1.01.08	Safety Valve Springs and Gaskets for HP stage	1 Set
1.01.09	Safety Valve Springs and Gaskets for LP stage	1 Set
1.01.10	Valves (within the compressor house with actuators	2 nos of each type/ratings/ size.
1.01.11	Oil Pump/Motor	
1.01.11.1	Oil Pump and Motor complete assembly	1 Set
1.01.11.2	Pump impeller/rotor with shaft	1 Set
1.01.11.3	Set of bearings	2 Set

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

1.01.11.4	Set of Seals	2 Set
1.01.12	Drain / Moisture Trap	2 Set of each type/size.
1.01.13	Oil Cooler Gaskets & Seals	2 sets
2.00.00	AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM (As applicable)	
2.01.01	Pre filter element(Ceramic candle or as applicable)	2 sets
2.01.02	After filter element(Ceramic candle or as applicable)	2 sets
2.01.03	Valves & Valve Actuators (pneumatic/hydraulic)	2 sets
2.01.04	Heater coil for temperature stabilization (for HOC type)(as applicable)	2 sets
2.02.00	MEASURING INSTRUMENTS	
	1 Electronic Transmitters	
	(i) Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or 1 No. of each type and model, whichever is more
	2 Temperature elements	
	(i) RTD's* of each type and length	10% or 2 Nos. of each type and length Whichever is more
	ii) Thermocouples of each type like K-type, R-type, metal etc. and length *	10% or 2 Nos. of each type and length Whichever is more
	(iii) Thermowell for application like mill outlet temperature and SH/RH/Eco/ true gas temp. in furnace	10% or 2 Nos. of each type and length Whichever is more
	(iv) Temperature transmitters	10% of each type and length whichever is more
	3 Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make,

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	4	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	5% or 1 No. of each type and model whichever is more
	5	Dew Point meters	5% or 1 No. of each type and model whichever is more
2.03.00	MICROPROCESSOR BASED/PLC BASED CONTROL/ELECTRONIC BASED CONTRAL PANEL (IF APPLICABLE)		
1		Fully programmed controller of electronic modules of each type (as applicable)	10% or 1 no. whichever is more
2		Power supply module (if applicable)	10% or 1 no. whichever is more
2.04.00	Rotary drum type Air drying plant for Instrument Air system (As applicable)		
		Drive assembly consisting of motor, gear boxes, drive shaft & coupling	1 set
2.05.00		Air compressor motor	1 no. 1 no.

Notes :

- Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.
- Any fraction of a item shall mean the next higher integer.
- Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.
- Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.
- Unless stated otherwise a 'set' means items or sub-items required for each type/size range of the assembly/sub-assembly, required for complete replacement in one unit. It is further, intended that the assembly/sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/sub-assembly, these shall be considered as different types of assembly/sub-assembly.

3.00.00

FIRE DETECTION AND PROTECTION SYSTEM

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SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY		
1.0	PUMPS	Hydrant		Jockey
1.1	Impeller	1 Set		1 Set
1.2	Pump bearing (Incl. thrust brg, journal brg., line shaft brg.)	1 Set		1 Set
1.3	Pump shaft	1 Set		1 Set
1.4	Wearing rings	2 Sets		2 Sets
1.5	Shaft Sleeve	1 Set		1 Set
1.6	Bushings	2 Sets		2 Sets
1.7	Bearing housing (if provided)	1 Set		1 Set
1.8	Coupling bolts & nuts(with bushes)	1 Set		1 Set
	Above quantity/items are required for each type and rating of pumps being supplied under the contract			
2.0	DIESEL ENGINE (1 set means item required for 1 diesel engine)			
		Hydrant		
2.1	Sprayers/Injector	1 set		
2.2	Piston rings & sealing rings	1 Set		
2.3	Exhaust valve assembly	1 Set		
2.4	Springs	1 Set		
2.5	Packings and gaskets	1 Set		
2.6	Fuel oil filter elements with seals	2 Sets		
2.7	Fuel oil filter assembly	1 Set		
2.8	Lub. oil filter elements with seals	2 Sets		
2.9	Scraper rings	1 Set		
2.10	Solenoid coil for fuel valve	1 No.		
2.11	Corrosion inhibitor(if provided)	1 Set		

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY	
2.12	Big end & small end bearing of connecting rod	1 Set	
2.13	Speedometer	1 No.	
2.14	Speedometer wire	1 No.	
2.15	Rubber hoses of water line with mounting clamps	1 Set	
2.16	Cranking starter assembly complete	1 Set	
2.17	Lub. oil and fuel oil hoses with end connectors	1 Set	
2.18	Water pump belts	2 Sets	
	Above quantity/items are required for each type and rating of diesel engine being supplied under the contract		
3.0	FIRE HOSES WITH COUPLINGS		
3.1	7.5m long fire hoses (internal) with end connectors	10% of population	
3.2	15m long fire hoses (internal) with end connectors	10% of population	
3.3	15m long fire hoses (external) with end connectors	10% of population	
4.0	BRANCH PIPES WITH NOZZLES		
4.1	Nozzles with branch pipes & quick coupling ends (internal)	10% of population	
4.2	Nozzles with branch pipes & quick coupling ends (external)	10% of population	
5.0	DELUGE VALVE ASSEMBLIES		
5.1	Complete deluge valve assembly along with internals and accessories		
5.1.1	150 NB	10% of population (Min 1 Set)	
5.1.2	100 NB	10% of population (Min 1 Set)	
5.1.3	80 NB	10% of population (Min 1 Set)	

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY
5.1.4	50 NB	10% of population (Min 1 Set)
5.2	Clapper assembly complete (consisting of clapper seat rubber, screws, etc.)	
5.2.1	150 NB	10% of population (Min 1 Set)
5.2.2	100 NB	10% of population (Min 1 Set)
5.2.3	80 NB	10% of population (Min 1 Set)
5.2.4	50 NB	10% of population (Min 1 Set)
5.3	Solenoid coils	
5.3.1	150 NB	10% of population (Min 1 Set)
5.3.2	100 NB	10% of population (Min 1 Set)
5.3.3	80 NB	10% of population (Min 1 Set)
5.3.4	50 NB	10% of population (Min 1 Set)
6.0	VALVES (GATE/GLOBE/BUTTERFLY/NRV)	
6.1	Complete valves	5% of population of each type & size
6.2	Reduction gear operator(Gate/Globe/Butterfly)	10% of population of each type & size
6.3	Flap/door with pin(NRV)	10% of population of the each type & size
6.4	Disc(butterfly/globe)	5% of population of each type & size
6.5	Gate(Gate valve)	5% of population of each type & size
6.6	Stem(all types)	5% of population of each type & size
6.7	Seal rings(all types)	10% of population of each type & size
6.8	Flap rings(NRV)	10% of population of each type & size
6.9	Gaskets	10% of population of each type & size

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY
6.10	Bearing(Butterfly valve)	10% of population of each type & size
6.11	Motorized actuator of butterfly valve 300 NB	1 No.
7.0	BASKET STRAINERS / Y-TYPE STRAINERS for HVW/MVW SYSTEM	
7.1	Strainer elements with O-rings and stiffeners.	
7.1.1	Basket strainer	20% of population of each type & size
7.1.2	Y- Type strainer	20% of population of each type & size
8.0	MVW SPRAY SYSTEM	
8.1	Spray Nozzles	5% of population
8.2	QB Detectors	5% of population
9.0	HVW SPRAY SYSTEM	
9.1	Spray nozzles	5% of population
9.2	QB Detectors	5% of population
10.0	HYDRANT VALVE	
10.1	Hydrant valve complete (internal) single headed with instantaneous female coupling	20% of population
10.2	Hydrant valve complete (external) single headed with instantaneous female coupling	20% of population
10.3	Water monitor sets with nozzle branch pipe etc.	5% of population
10.4	Spindle with nuts of Hydrant valve	10% of population
10.5	Bonnet, gland nut, rubber assembly of hydrant valve	10% of population

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY
10.6	Seat, check nut, washer assembly of hydrant valve	10% of population
10.7	Rubber washer for female coupling	10% of population
10.8	Instantaneous female coupling assembly complete for hydrant valve	10% of population
10.9	Lock pin assembly for hydrant valve	10% of population
11.0	FIRE DETECTORS	
11.1	Multisensor detectors (Addressable)	5% of population
11.2	In Indicators assembly for smoke detectors provided in false ceiling (Response indicator)	5% of population
12.0	PORTABLE EXTINGUISHERS	
12.1	Water type	10% of each type
12.2	Foam Type	10% of each type
12.3	CO ₂ Type	10% of each type
12.4	Dry Chemical Type	10% of each type
13.0	MOBILE EXTINGUISHERS	
13.1	Foam type	10% of each type
13.2	CO ₂ Type	10% of each type
13.3	Dry Chemical Type	10% of each type
14.0	INERT GAS EXTINGUISHING SYSTEM	
14.1	Nozzles	2 Nos. of each size/type
14.2	Automatic & Manual release system	1 No. of each size/type
14.3	Cylinder valve with safety pressure relief device	1 No. of each size/type
14.4	Flexible hoses(if applicable)	5 Nos. of each size/type

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY
14.5	Solenoid coils	2 Nos. of each size/type
15.0	FIRE ALARM PANEL & REPEATER FIRE ALARM PANEL	
15.1	Fuses	100% of population
15.2	Indicating lamps	100% of population
15.3	Push Button	10 Nos. of each type and rating
15.4	Power supply modules	10% or 1 No. of each type & rating whichever is more
15.5	Control modules, loop cards modules, isolator cards	10% or 1 No. of each type, whichever is more.
15.6	LCD display of each type unit of panel	1 No.
15.7	Cartridges for printers	2 Nos.
15.8	Interface unit / modules for non-addressable devices, auxiliary / output relay modules, control modules, supervisory control modules and any other electronic modules	10% or 1 No. of each type whichever is more.
15.9	LED's of each type	100% of population.
15.9.1	Power supervision relay	4 Nos. of each type.
15.10	Fire screen / alarm buzzer	1 No. of each type
16.0	ELECTRICAL	
16.1	Electrical Actuator	10% or 1 No. of each type, model and rating whichever is more.
17.0	CONTROL AND INSTRUMENTATION	
17.1	MEASURING INSTRUMENTS	
17.1.1	All types of Local indicators	2 Nos. of each make, model and type

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY
17.1.2	Process Actuated Switch Devices : (All types of Pressure, diff. pressure, flow, temperature, level switch devices).	2 Nos. of each type and model
17.1.3	All type of Electronic Transmitters and Ultrasonic Transmitters including sensors.	10% or 1 No. of each type and model whichever is more.
17.1.4	Limit switches for isolation valves	2 Nos. of each type
18.0	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)	
18.1.1	Valves	1 No. of each type, class, size and model.
18.1.2	2 way, 3 way, 5 way valve manifolds	1 No. of each type, class, size and model.
18.1.3	Fittings	5% or 1 No. of each type, class, size and model whichever is more.
19.0	CABLES	
19.1.1	Pre fabricated cable of each type.	1 No. of each type, size and model.
19.1.2.	Pre fabricated cable connector	1 No. of each type and model.
19.1.3	Other cables (including core cable, short-term fire proof cable, fiber optic cables, etc.)	5% of each type, pair/ core and size of actual installed quantity.
20.0	PLC CONTROL SYSTEM	
20.1.1	Power Supply Unit	1 No. of each type and model,
20.1.2	Electronic modules(I/O modules, communication modules and any other module used in the system)	10% or 1 No. of each type and model, whichever is more.
20.1.3	Central Processor Unit	1 No. of each type and model
20.1.4	Interconnecting Cables	10% of each type & size
20.1.5	Cooling Fan in PLC system / cabinet	2 Nos.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	ITEM DESCRIPTION	QUANTITY
20.1.6	Indication lamps of all types	100%
20.1.7	Graphical Interface Unit	1 No.
21.0	24V – DC POWER SUPPLY SYSTEM	
21.1.1	CTs, CVTs, VTs, chokes, AC/DC isolators, contactors, timers, relays	5% or 2 Nos. of each type and rating whichever is more.
21.1.2	Fuses of each type and rating	200%
21.1.3	Fuse free Circuit breakers	5% or 5 Nos. of each type and rating whichever is more.
21.1.4	Electronic modules of all types	One No. of each type
21.1.5	Indication lamps	100%
21.1.6	Cooling Fans	1 No. of each type
21.1.7	Indicators	1 No of each type and rating
21.1.8	Relays of all types including overload relays	2 Nos. of each type and rating
21.1.9	Batteries	5% or 2 nos. of each type & rating whichever is more

4.00.00 VENTIATION SYSTEM

1.0	MOTOR for supply air fan/Exhaust Air fan/ Roof Extractor	1 no. each type and rating
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Notes :

1. Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.
2. Any fraction of a item shall mean the next higher integer.
3. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.
4. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.
5. Unless stated otherwise a 'set' means items or sub-items required for each type/size

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

range of the assembly/sub-assembly, required for complete replacement in one unit. It is further, intended that the assembly/sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/sub-assembly, these shall be considered as different types of assembly/sub-assembly.

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SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

ANNEXURE-IB

LIST OF MANDATORY SPARES

ELECTRICAL:

Mandatory spares for Dry Type Transformers

S. No.	Components	Qty (each/type)
1	HV Bushing (if applicable)	1 No.
2	LV Bushing (if applicable)	1 No.
3	LV Neutral Bushing (if applicable)	1 No.
4	Complete Winding Limb(HV and LV)	1 No. each
5	WTI (if applicable)	1 No.
6	Set of Thermister /RTD with associated leads complete for one transformer	1 Set

Note: 1 (one) set consists of quantities required for 1 complete transformer.

MANDATORY SPARES for oil filled transformers and SUT:

S. No.	ITEMS DESCRIPTION	SUT	Aux. Trans. (for each rating)
1.	HV Bushing with metal parts and gaskets (See Note 1)	3 No.	3 No.
2.	HV Neutral bushing with metal parts and gaskets	2 Nos.	1 No. (if applicable)
3.	LV bushing with metal parts and gaskets (See Note 1)	3 No.	3 No.
4.	LV Neutral bushing with metal parts and gaskets	-	1 No. (if applicable)
5.	WTI with contacts	1 No.	1 No.
6.	OTI with contacts	1 No.	1 No.
7.	Pressure relief device	1 No.	1 No. (if applicable)
8.	MOG	1 No.	1 No.
9.	Buchholz relay complete	1 No.	1 No.
10.	Oil surge relay	1 No.	-
11.	Set of gaskets (See Note 2)	1 Set	1 Set
12.	Set of valves	2 No. of each type/size	2 No. of each type/size
13.	Cooler fan with motor	2 No.	-
14.	Air cell for conservator	1 No.	1 No. (if applicable)

Note 1: Each mandatory spare OIP bushing shall be provided with suitable "stand".

Note 2: 1 set consists of gaskets required for 1 (one) No. transformer for the following

(a) Protection and monitoring devices

(b) Cooler circuit

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(c) Largest inspection cover, if applicable

(d) HV/LV turret, if applicable

MANDATORY SPARES for LT SWITCHGEAR:

LT Switchgear		
Part A:		
S. No.	Item Description	Quantity
1	Complete breaker	10% of each type & rating(min 1 No)
2	Ammeter	2 Nos of each type, size & range
3	Voltmeter	2 Nos of each type, size & range
4	Relays	10 % of each type (min 2 Nos)
5	Bus bar support insulators	10 Nos.
Part B:		
S. No.	Item Description	Quantity
1	Spring charging motors	3 Nos of each type & rating
2	Aux. Contact set	6 sets of each type & rating
3	Limit switches	10 Nos of each type.
4	Arc chutes	10% of each type & rating
5	Fixed contact set	3 Nos sets of each type & rating
6	Moving contact set	3 Nos sets of each type & rating
7	Arcing contact	3 Nos sets of each type
8	Charging spring	2 Nos of each type & rating
9	Current transformer	3 Nos of each type & ratio
10	Closing coil	6 Nos of each type & rating
11	Trip coil	6 Nos of each type & rating
12	CT for Bimetal O/L relays	3 Nos of each type & rating
13	Voltage transformer	3 Nos of each type & ratio
14	Control supply transformer	3 Nos of each type and rating
15	(a) Power contactor	2 Nos of each type & rating
	(b) Coil of above contactor	2 Nos of each type & rating
16	Air break switches/ MCCBs	3 Nos of each type & rating
17	DP air break switches(DC)	3 Nos of each type & rating
18	Control & selector switches	3 Nos of each type & rating
19	Control fuses & neutral links	Total 50 Nos (Fuses) & 10 Nos (Neutral links), to cover all the ratings.
20	Indicating lamps	Total 30 Nos to cover all the types & ratings
21	Vertical bus bar dropper support insulators	25 Nos.
22	Bus duct flexible connectors (both transformer and switchgear end)	1 set for three phases of each type & size

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

23	(a) Primary disconnect in MCC (Bus bar end)(Male/female contact)	Total 15 Nos. proportionately divide for all ratings
	(b) Secondary disconnect in MCC (Cable end)	Total 15 Nos. proportionately divide for all ratings
24	Push buttons	10 Nos of each type
25	Power fuses	Total 20% proportionately divide for all ratings (min 3 Nos)
26	Thermal Bimetal relays	Total 5%. proportionately divide for all ratings (min 1 No)
27	Current transducers	2 Nos of each type & rating
28	Voltage transducers	2 Nos of each type & rating
29	Busbar aluminium flat pieces	12 meters of each type & rating
30	Busbar angles/formed pieces for breaker	2 Nos. of each type
31	Terminal blocks	12 Nos of each type & rating

LIST OF MANDATORY SPARES FOR MV SWITCHGEAR:

MV Switchgear (33kV/11kV)		
1	Breaker of each rating	10% of each type & rating (Min 1 No.)
2	Numerical relays	10% of each type (Min 2 Nos)
3	Aux. Relays/ Lock out relays/ Timers(if applicable)	10% of each type (Min 2 Nos)
4	Bus bar support insulators	12 Nos.
5	Energy meter of each type & range	1 Nos. of each type
6	Spring charging motor complete	2 Nos. of each type.
7	Current transformer of each type & ratio	3 Nos. of each type
8	Potential transformer of each type & ratio	3 Nos. of each type
9	Shunt trip coil	5 Nos. of each type & rating
10	Closing coils	5 Nos. of each type & rating
11	Moving contact assembly of each rating (One set means complete replacement for one breaker)	2 sets
12	Stationary (fixed) contact of each rating (One set means complete replacement for one breaker)	2 sets
13	Bus seal off bushings	3 nos. of each type & size
14	Limit switches	10 Nos. of each type
15	Control switches	2 Nos. of each type
16	Selector switches	2 Nos. of each type
17	Isolation switch for the control supply	2 Nos.
18	Circuit breaker auxiliary contact assembly	6 Nos. of each type & rating
19	Indicating lamps with holders	20 set
20	(a) Fuse base and holder	12 Nos.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

	(b) Fuse link	12 Nos.
21	Isolating contact (fixed & moving)(one set means male & female contacts of one complete breaker)	4 sets of each rating
22	Terminal blocks	6 Nos.
23	Multiple pin plug contact assy. with cables (male & female)	6 Nos.
24	Inter-phase barrier	2 Nos. of each type
25	Vacuum Contactors with HRC fuses (if applicable)	2 Sets (One set= Three fuses)
26	Surge arresters (if applicable)	3 Nos. of each rating

LIST OF MANDATORY SPARES FOR GENERATOR & AUXILIARIES:

	Generator & Auxiliaries	
1	Complete Generator bearings	1 set
2	Exciter bearings (if applicable)	1 Set
3	Brush- holder assembly with housing for exciter for rotor winding E/F sensing (if applicable)	1 Set
4	Brush Gear assembly complete with brushes for slip ring (if applicable)	1 Set
5	Gaskets of all types for Generator	1 Set
6	Brush- holder assembly for shaft earthing (if applicable)	1 set
7	Complete Generator phase and neutral bushings with terminal connectors for one machine	1 set
B	Excitation system	
a	Relays	2 Nos. of each type
b	Electronic modules	1 Nos. of each type
c	Rectifier element with heat sinks, RC network and fuses	1x100% of one bridge
d	AC/DC field breaker	1 No
e	Over voltage suppressor	1 Sets
f	Control transformers of each type/rating	1 Set
g	Excitation Transformer	1 No
h	Field flashing breaker	1 No
i	Over voltage suppressor	1 Set

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

j	Initial excitation diode	2 Sets
k	Compatible HMI / Laptops for excitation system	1 no. of each type
l	Software & Programmes / programmed EPROMs with necessary hardware/software keys for multiple use.	1 set of each type for one unit
m	Network switches / ethernet switches with connectors, cables and all accessories complete for one unit.	1 no. of each type
C	VFD drive	01 no of each type & rating.
D	Motors	1no of each type and rating

LIST OF MANDATORY SPARES FOR GENERATOR & AUXILIARIES:

S.no.		Item Description	Quantity
1		MV Busduct	
1		11 kV Busduct	
	1	Support insulators	25 Nos.
	2	Three phase set of flexible terminal connectors for switchgear end of each type & rating	1 set
	3	Three phase set of flexible terminal connector for transformer end of each type & rating	1 set
	4	Three phase set of flexible terminal connector for Generator end of each type & rating	1 set
	5	Three phase set of flexible terminal connector for PTSP and NG Cubicle end of each type & rating	1 set
	6	Seal off bushings of each type & rating	3 nos.
2		NG Transformer for Generator	1 No.
3		Current trans formers	
	a	Generator CTs of each type & rating	3 Nos.
4		VT & SP Cubicles	
	a	Lightning arrestor	3 Nos.
	b	VT for Generator each type and rating	3 Nos.
	c	Surge capacitor	3 No.

NOTE: ONE SET MEANS COMPLETE REQUIREMENT OF ONE PHASE, WHEREVER NOT SPECIFIED

LIST OF MANDATORY SPARES FOR DG SET:

S.no.	Item Description	Quantity
1	Ammeter 96x96mm, (0-200 amp) Accuracy class:1.0	1 No.
2	A.C. Voltmeter 96x96 mm, (0-15 kV) Accuracy class:1.0	1 No.
3	Coil assembly 24 Volts	2 set
4	Solenoid coil for fuel oil system	2 No.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

5	Complete rotating rectifier assembly for alternator	1 set
6	Voltage regulator complete	1 set
7	Switches	1 No. of each type & rating
8	Power contactors	2 No. of each type & rating
9	Auxiliary contactors	1 No. of each type & rating
10	DC starter assembly with clutch engaging and disengaging arrangements complete with motor	1 No.
11	Coil for contactor(for both power and Auxiliary contactors)	2 No. of each type & rating
12	Timer	1 No. of each type & rating
13	Auxiliary relays	1 No. of each type & rating
14	Current transformers	1 No. of each type
15	Voltage transformers	1 No. of each type
16	Battery charging rectifier diodes	4 Nos.
17	Fuses	6 No. of each type & rating
18	Start/Stop push buttons	2 No. of each type & rating
19	Indication lamps	20%
20	Indication lamp holders	10%
21	On/Off isolator	1 No.

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ANNEXURE: IC

MANDATORY SPARES LIST FOR CONTROL AND INSTRUMENTATIONS

CONTROL SYSTEM:

SI No	ITEM	QUANTITY
1.	HMI Devices	
A)	Work station	
	(i) OWS with licensed software	1 no. of each type and model
B)	Network Components	
	(i) Switch/repeaters/hubs/firewalls for PLC/ DDCMIS including Station LAN etc.	2 nos. of each type and model
2.	Cables and Connectors.	
	(i) Prefab interconnecting cables with connectors	2 no. of each type and length.
	(ii) System bus cable with connectors	2 no. of each type and length.
	(iii) I/O bus cable with connectors for remote I/O units	2 no. of each type and length.
	(iv) Loose Connectors	5 nos. (sets) of each type
3.	Power Supply Modules & Power Packs for control system	20% or 2 nos. of each type model and rating, whichever is more.
4.	Electronic modules of each type and model for control system, Data communication system, Master and Slave Clock etc. (This shall include all type of cards like I/O cards, Remote I/O cards, communication/Interface cards, controller cards, CPU module or Card, logic cards, etc.)	20% or 2 Nos of each type, model and rating whichever is more
5.	Bus coupler/Interface hardware / other communication devices.	20% of each type and model or minimum 2 nos. whichever is more.
6.	Relays	10% of each type and model or minimum 2 nos. whichever is more
7.	Batteries used for battery backup of RAMs(if applicable)	10% of each type and model or minimum 2 nos. whichever is more
8.	Fuses	200 % of each type and

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		rating
9.	Cooling fans for Power supply and cabinets.	10 % of each type and model
10	Intelligent mini UPS for workstation server, PCs, LVS, L3 switch.(if applicable)	1 no. of each size and rating

MEASURING INSTRUMENTS:

Sl. No.	ITEM	QUANTITY
1 AAQMS (SO₂, NO_x, CO, Mercury, Ozone, Dust monitoring)		
(i)	Analyzer for SO ₂ , NO _x , CO, Dust monitoring	1 no. complete instrument of each type and model
(ii)	Electronic Card Assemblies/PCBs, power supply modules	10% of each type and model
(iii)	Set of Gaskets/"O" rings/ seals	200% of each type, model, rating and size
(iv)	Heater Assembly-	20% of each type and model
(v)	Temp. Sensor	20% of each type and model
(vi)	Solenoids	2 nos. of each type, model and rating
(vii)	Filters, light source, etc.	100% of each type, model and rating
(viii)	Calibration gases, calibration cell and other consumables for calibration: - of all types and ranges.	One year supply.
(ix)	Pump repair kit (If applicable)	One set
2. (I) CEMS (SO_x, NO_x, CO, CO₂, PM, NMHC):-		
(a)	Analyzer for SO _x , NO _x , CO ₂ , CO.	1 no complete instrument of each type and model.
(b)	Flue gas flow measurement	1 no. complete instrument alongwith sender/receiver unit
(c)	Stack Opacity measurement	1 no. complete instrument alongwith sender/receiver unit
(d)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating
(e)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(f)	Temp. Sensor	20% of each type and model
(g)	Heater assembly, Cooler assembly	20% of each type and model
(h)	Complete Probe with shield assembly (Not applicable for Insitu-path)	1 no. of each type and model

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(i)	Solenoids	2 nos. of each type, model and rating
(j)	Filters, light source, sensor, detector, etc.	200% of each type, model and rating
(k)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply
(l)	Heavy duty blower assembly	1 no. of each type, size and rating.
(m)	Rotameter/Air flow meter	2 nos. of each type, model and rating
2 (II)	Oxygen Analyzer (Low & High Temp.)	
(a)	Oxygen measurement instrument	1 no complete instrument (along with probe assembly) of each type and model
(b)	Electronic card assembly/ PCBs, power supply modules	10% of each type, model and rating
(c)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(d)	Temp. Sensor	20% of each type and model
(e)	Heater assembly	20% of each type and model
(f)	Solenoids	2 nos. of each type, model and rating
(g)	Filters	100% of each type, model and rating
(h)	Calibration gases of all types and ranges.	one year supply
(l)	Rotameter/Air flow meter	2 nos. of each type, model and rating
3	Measuring Instruments	
a)	Transmitters	
(i)	Transmitters of all type, range and model no. (For the measurement of Pressure, differential pressure flow, level, temperature etc.)	10% of each type and model
(ii)	Interface modules at field(between field transmitter & DDCMIS)like Zener barrier, power supply isolator, isolater(as applicable)etc.	10% of each type
b)	Temperature elements	
(i)	RTD's	10% of each type and length
(ii)	Thermocouples	10% of each type and length

POWER SUPPLY SYSTEM:

Uninterrupted Power supply (UPS) System including Static Switches for Sub Distribution

(i)	Silicon controlled thyristors, diodes and power transistors.	100 %
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SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

(ii)	Capacitors	1 set
(iii)	CT's, CVT's VT's chokes, AC/DC isolators, contactors, timers, relays.	10% of each type and rating.
(iv)	Fuses of each types and rating	200%
(v)	Fuse free Circuit breakers	5% of each type and rating
(vi)	Electronic modules	10% of each type
(vii)	Indication lamps	100% of each type
(viii)	Lamp holders with series resistor, if any	10% of each type
(ix)	Cooling Fans	2 nos. of each type
(x)	Digital/analog panel meters/indicators	1 no. of each type
(xi)	Relays of all types including overload relays.	10%
(xii)	Static Switch	10% or minimum 1 no (whichever is higher) of each type and rating

INSTRUMENTATION CABLE, INTERNAL WIRING:

SI No	ITEM	QUANTITY
(i)	Pre fabricated cable of each type (other than DDCMIS application) (if applicable)	10% of installed quantity.
(ii)	Pre fabricated cable connector (other than DDCMIS application) (if applicable)	10% of each type and model
(iii)	Other cables (Instrumentation and Control cable)	5% or 500 mtrs whichever is more for each type, pair and size of actual supplied quantity.

CCTV:

SI No	Item	Quantity
(i)	Camera	10% of each type or 2 nos. whichever is more
(ii)	Full function keyboard & Joystick	1 no.
(iii)	Client Work Stations with monitor	1 no.
(iv)	Network Switches	10% of each type ,make ,model etc.

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(v)	Camera/Database Server	1 no.
(vi)	Mechanism motors	10%
(vii)	Media Converters	10%
(viii)	Camera mounting arrangement.	10% of each type or 2 nos. whichever is more

PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE):

Sl. No.	ITEM	QAUNTITY
(i)	Valves of all types	10%
(ii)	2 way, 3 way, 5 way valve manifolds	10% of each type, class, size and model
(iii)	Fittings	10%
(iv)	Purge meters	5% of each model
(v)	Filter regulators	20% of each model

ELECTRIC ACTUATORS:

Sl. No.	ITEM	QAUNTITY
(i)	Actuator	1 no. of each type & rating
(ii)	Electronic PCB of all types	10% of each type & model
(iii)	Absolute Encoder (replaceable part)	5% of each type & model
(iv)	Electronic Torque sensor	5% of each type & model

CONTROL VALVES, ACTUATORS AND ACCESSORIES:

Sl. No.	ITEM	QAUNTITY
(i)	Pneumatic Control Valve actuator assembly	10% or 1 Nos. of each type, model and rating, whichever is more.
(ii)	Diaphragms, O' rings, seals etc.	100% of all types, make etc.
(iii)	Pressure Gauges of all types, make, rating etc.(if applicable)	10% or 2 nos. of each type whichever is more.
(iv)	Solenoid valves (if applicable)	10% or 2 nos. of each type whichever

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

		is more.
(v)	Control valve positioners/smart positioners and its accessories	10% or 2 nos. of each type, model and rating, whichever is more.
(vi)	E/P converters(if applicable)	10% or 2 nos. of each type, model and rating, whichever is more.

PUBLIC ADDRESS SYSTEM

(A) Call Stations & Amplifiers

Sr. No.	Item	Quantity
(i)	Call station for outdoor area with amplifier	10 % of each type, make, model etc.
(ii)	Call station for indoor area desktop mounting type with amplifier	10 % of each type, make, model etc.
(iii)	Master Control Unit (MCU)	10 % of each type, make, model etc.
(iv)	Portable Call station with minimum 2 mtrs connecting cable.	10 % of each type, make, model etc.
(v)	Standalone amplifier	10 % of each type, make, model etc.

(B) Loudspeakers

Sr. No.	Item	Quantity
(i)	Outdoor Industrial horn type loudspeaker	10 % of each type, make, model etc.
(ii)	Indoor wall mounted cone type loudspeaker	10 % of each type, make, model etc.

(C) Network devices and accessories

Sr. No.	Item	Quantity
(i)	Network Switches	10% of each type, make, model etc.
(ii)	Media Converters	10% of each type, make, model etc.
(iii)	Complete Server with software & its applicable license	10% of each type, make, model etc.
(iv)	PC Station with software & its applicable license	10% of each type, make, model etc.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

Note:

1. In case the main population of any item is only one no., then the spare quantity shall also be one no., overriding requirements indicated in above list of Annexure I C.
2. Wherever the quantity is given only in percentage, the spare quantity shall be distributed into various ranges/size/rating/type (as the case may be) in the same proportion of the main population. For the quantities coming less than 1 (one), shall be treated as 1 (one) only.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

ANNEXURE ID

MANDATORY SPARES FOR ROOF TOP SOLAR PV

Bidder shall maintain following mandatory spares, consumables & various components of Solar PV plant for smooth running during O&M period. Bidder shall also replenish the consumed mandatory spares during the O&M period. The bidder shall also mention the source of supply.

1. Solar PV module - 1% of total population
2. Inverter - 1 No of string inverter of highest size of supplied capacity.
3. Flexible Solar DC cable – 500 m.
4. DC side Surge Arrestor, If applicable – 1 No

Wherever quantity has been specified as percentage (%) and the quantity of mandatory spares works out to be a fraction, the same shall be rounded off to next higher whole number.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

ANNEXURE II

LIST OF TOOLS & TACKLES

A. Mechanical:

S.No.	Item Description	Size	Qty.
1.	Box wrenches	10-11	02 nos.
2.	Box wrenches	12-14	02 nos.
3.	Box wrenches	13-17	02 nos.
4.	Box wrenches	19-22	02 nos.
5.	Box wrenches	30-32	02 nos.
6.	Box wrenches	24-27	02 nos.
7.	Engineers wrench	10-11	02 nos.
8.	Engineers wrench	12-14	02 nos.
9.	Engineers wrench	13-17	02 nos.
10.	Engineers wrench	19-22	02 nos.
11.	Engineers wrench	24-27	02 nos.
12.	Engineers wrench	30-32	02 nos.
13.	Engineers wrench	36-41	02 nos.
14.	Engineers wrench	46-50	02 nos.
15.	Combination wrench	AL36	02 nos.
16.	Key for hexagon socket screw	4	02 nos.
17.	Key for hexagon socket screw	5	02 nos.
18.	Key for hexagon socket screw	6	02 nos.
19.	Key for hexagon socket screw	8	02 nos.
20.	Key for hexagon socket screw	10	02 nos.
21.	Key for hexagon socket screw	12	02 nos.
22.	Key for hexagon socket screw	14	02 nos.
23.	Key for hexagon socket screw	17	02 nos.
24.	Bit, hexagon socket screw 1/2" squ	6	02 nos.
25.	Bit, hexagon socket screw 1/2" squ	8	02 nos.
26.	Bit, hexagon socket screw 1/2" squ	10	02 nos.
27.	Bit, hexagon socket screw 3/4" squ	14	02 nos.
28.	Bit, hexagon socket screw 3/4" squ	19	02 nos.
29.	Socket wrench 1/2" square drive	10*12.5	02 nos.
30.	Socket wrench 1/2" square drive	13*12.5	02 nos.
31.	Socket wrench 1/2" square drive	17*12.5	02 nos.
32.	Socket wrench 1/2" square drive	19*12.5	02 nos.
33.	Socket wrench 1/2" square drive	24*12.5	02 nos.
34.	Socket wrench 1/2" square drive	13*12.5L	02 nos.
35.	Socket wrench 1/2" square drive	24*12.5L	02 nos.
36.	Socket wrench 3/4" square drive	41*20L	02 nos.
37.	Socket wrench 3/4" square drive	30*20	02 nos.
38.	Torque wrench	20-100Nm	02 nos.
39.	Torque wrench	75-400Nm	02 nos.
40.	Torque wrench	150-800Nm	02 nos.
41.	Ratchet handle with 3/4" in square	3/4"-553	02 nos.
42.	Ratchet handle with 3/4" in square	B12.5	02 nos.
43.	Speed brace	B12.5*500	02 nos.
44.	Extension bar	B12.5*250	02 nos.
45.	Adapter socket wrench	A20*12.5	02 nos.
46.	Swivel head	3/4"-554	02 nos.
47.	Pliers for securing ring	A40	02 nos.
48.	Screw driver	2*12	02 nos.
49.	Tool locker	TLR-1200	02 nos.
50.	Stud remover	5-20	02 nos.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

Tools for main bearing:			
51.	DOG for main bearing		01 no.
52.	DOG for thrust bearing		01 no.
Tools for cylinder liner:			
53.	Lifting tools		01 no.
54.	Honing tool for deglazing of cyl. Liner		01 no.
55.	Tool for removing antip. ring		01 no.
56.	Grinding tool for liner and cyl. Head S+		01 no.
Tools for piston:			
57.	Lifting tool for piston		01 no.
58.	Piston ring pliers 320		01 no.
59.	Fitters tool for piston		01 no.
60.	Pliers for retaining rings ZGJ-5+ZSJ51		01 no.
61.	Jack for piston		01 no.
Tool for connecting rod:			
62.	Mounting and Dismounting tools for conn. Rod .Big		01 no.
63.	Tool for connecting rod		01 no.
64.	Limiter for piston		01 no.
Hydraulic tightening tools for connecting rod:			
65.	Hydraulic tighten. Tool for M27*2 screw		02 nos.
66.	Mounting tool 5033 4V80D0032		01 no.
67.	Pin for tight of M27*2 nuts		01 no.
68.	Assembly tool for intermediate gear		01 no.
Tools for cylinder head:			
69.	Lifting tool		01 no.
70.	Device for engine valves 5032 1V12		01 no.
71.	Turning tool for grinding of valves		01 no.
72.	Extractor for start and inj. Valve		01 no.
73.	Adapter		01 no.
74.	Valve clearance feeler		01 no.
75.	Extraction tool for injection valve		01 no.
76.	Extraction mandrel for valve guide		01 no.
77.	Lifting tool for rocker arm assembly		01 no.
Tools for injection equipment(If Applicable):			
78.			
79.	Socket 05020036(56-36) 36		01 no.
80.	Open-end wrench(change over)		01 no.
81.			
82.	Moving tool 5004 2V35A1568		01 no.
83.	Lifting device 6002 2V16F0124		01 no.
84.	Tool for conn. Piece flan. Screw		01 no.
85.	Extraction tool 6002 2V16L0644		01 no.
86.	Part digital depth gauge W. data O 150MM		01 no.
87.	Base single extension base 180MM		01 no.
88.	Bracket for nozzle removal		01 no.
89.			

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

Tools for hydraulically tension M42 screw connection:			
90.	Hydraulic tightening tool M42		02 nos.
91.	Distance bush for hydraulic tool		02 nos.
92.	Pin for tensioning tool		01 no.
93.	Extraction for M42 stud		01 no.
94.	Distance sleeve for tightening of		02 nos.
95.	Elbow union for tightening tool		02 nos.
Tools for hydraulically tensioned M80 screw connection:			
96.	Hydraulic tool for camshaft and interme		01 no.
97.	Support 5001 2V13L0113		01 no.
98.	Mounting and removal Tool F. Stud		01 no.
99.	Fastening arm for hydraulic Tool M80X6		01 no.
100.	Lifting device for hydraulic tool		01 no.
Tools for hydraulically tensioned M60 screw connection:			
101.	Hydraulic tightening tool		02 nos.
102.	Hydraulic cylinder		04 nos.
103.	Extractor tool		01 no.
104.	Pin		01 no.
105.	Lifting tool		01 no.
106.	Lifting tool for hydraulic cylinder		01 no.
High pressure pump(1000 bar):			
107.	Hydraulic pump 1000 bar		01 no.
108.	Hose assembly for tightening tool L=820		02 nos.
109.	Hose assembly for tightening tool		03 nos.
Low pressure pump(150 bar):			
110.	Low pressure handpump		01 no.
111.	Hose, low pressure pump		02 nos.
Miscellaneous tools:			
112.	Mounting tool		01 no.
113.	Hydraulic cylinder		01 no.
114.	Pressure testing device		01 no.
115.	Deflection indicator		01 no.
116.	Locking plate		08 nos.
117.	Securing pin		16 nos.
118.	Lifting eye bolt		01 no.
119.	Lifting eye bolt		01 no.
120.	Wrench		01 no.
121.	Inhex socket 17X20(59-17)		01 no.
122.	Ring spanner		01 no.
123.	Extractor plate		01 no.
124.	Extractor		01 no.
125.	Tool		01 no.
126.	Mounting tool		01 no.
127.	Pressure testing device		01 no.
128.	Pump		01 no.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

B. ELECTRICAL TESTING EQUIPMENT AND T&P

S. No.	Item Description	Quantity
1	Oil BDV Measurement kit- Automatic oil testing unit for checking BDV of transformer oil upto 80kV.	Refer Sub Chapter II-E-13 Volume II, Sec VI Part B
2	Oil tan delta and resistivity measurement kit.- Suitable for measurement of Volume resistivity, Di-electric constant, Watt loss, loss factor with elevated temperature read out for transformer oil.	
3	Capacitance & Tan delta meas. Equip. (with cables etc.)- 0-10kV (Fully Automatic)	
4	Winding Resistance measurement kit	
5	Off Line laboratory model oil DGA kit	
6	Oil tanker, wheel mounted, 5 kL capacity	
7	Fully automatic AC high voltage test kit, upto 25 kV/ 5A suitable for testing Generator and associated busduct.	1 no.
8	Fully automatic DC high voltage 0- 40 KV/ 50 mA test kit	1 no.
9	Dual channel digital storage oscilloscope with Fast Fourier Transform analysis	1 no.
10	Step voltage injector for testing of Excitation system with voltage range from 0 - 1.5 Volts and voltage selectable in steps of 0.1 Volts.	1 no
11	One complete set of torque wrenches of different sizes	1 no.
12	Hydraulic crimping tools with dies	1 set
13	Fully automatic portable micro-ohmmeter, winding resistance measurement kit for generator.(stator and rotor)	1 no.
14	Portable earth resistance measurement kit based on three spike method	1 no.
15	Portable earth resistance measurement kit based on Staveless method(clamp on type)	1 no.
16	Precision grade 0.1 KV- 5 kV motorised megger	1 no.
17	Bearing puller based on induction heating method suitable till Generator rating	1 no.
18	Fully automatic Vacuum bottle testing kit	1 no.
19	Motor greasing device	1 no.
20	Fully automatic Battery impedance measurement test kit capable of measuring and storing specific gravity of acid, temperature of cell etc. with data storage facility.	1 no.
21	Fully automatic battery discharge unit	1 no.
22	Fully automatic portable cable fault locator	1 no.
23	Precision grade Digital Phase angle meter	2 nos.
24	Precision grade 3 1/2 digit digital multimeter with suitable calmp on meters	6 nos.
25	Precision grade clamp on current measurement kit suitable for measuring spill current in mA accurately.(Current range:0- 100 mA)	3 nos.
26	Portable panel cutting machine.	2 nos.
27	Complete set of screw drivers and nut drivers suitable for working in relay panels	3 nos.
28	Fully automatic digital megger (0-15 kV)	2 nos.
29	Maintenance tools and accessories for maintenance of LT MCC	2 nos.

SCOPE OF SUPPLY & SERVICES, TERMINAL POINTS AND EXCLUSIONS

30	Maintenance tools and accessories for maintenance of HT MCC	2 nos.
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PART-A

VOLUME – IV

**PLANT PERFORMANCE AND DESIGN
PHILOSOPHY**

ANDAMAN & NICOBAR GAS POWER PROJECT (50MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART A	VOLUME- IV	Page 1 of 28
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PLANT PERFORMANCE AND DESIGN PHILOSOPHY

1.00.00 GENERAL

The plant shall be complete in all respects and shall include all the equipment, systems and plant services necessary for safe, reliable and trouble free operation in the operating regimes and duty conditions specified in the Technical Specifications. Design of the plant shall take into account convenience of access, ease of maintenance, operational flexibility, the latest applicable statutes/ regulations/ safety codes and the climatic conditions particular to the site.

Broad design requirements for the power plant are as follows:

- a. Plant Type : RLNG fired open cycle Engine Power plant.
- b. Engine : Medium Speed Type for 50 Hz Electric Power Generation Applications.
- c. Design Reference conditions for guaranteed performance : As per Clause 3.01.01, Volume-IV, Part A.
- f. Operating Capability : Base Load, Cyclic Loading and Daily start/stop
- g. Fuel : RLNG
- h. NOx Emission level : As per Clause 6.02.00, Volume-IV, Part A.
- i. Cooling Water Cycle : Close cycle with Radiator cooling

Detailed design requirement for the plant is specified in this Volume. Detailed equipment specification shall be as per the respective Chapters of Part – B of Technical Specifications.

2.00.00 PLANT CONFIGURATION AND PLANT CAPACITY

Configuration: Genset modules to meet plant net capacity as 50 MW $\pm$ (10%) (i.e. 45 MW to 55 MW) with 4 to 6 identical units.

Bids with total plant net capacity less than 45 MW shall not be considered for evaluation and shall be rejected & any net output in excess of 55MW shall not be taken into consideration for evaluation.

Availability: Bids with Plant availability less than 90% shall not be considered for evaluation and shall be rejected.

3.00.00 PERFORMANCE CRITERION

3.01.00 Reference Conditions for Guaranteed Performance

3.01.01 Guaranteed Performance of each Genset Module shall be at the following reference conditions:

- a. Fuel : RLNG; Composition as per the 'Typical' composition given in Annexure – IA of Project Information (Vol.- II). For calculating LHV,

ANDAMAN & NICOBAR GAS POWER PROJECT (50MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART A	VOLUME- IV	Page 2 of 28
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PLANT PERFORMANCE AND DESIGN PHILOSOPHY

factor of 1.11 for GHV/HHV may be considered. Further, Bidder may calculate Methane number / Heating value for calculating the guarantee performance.

b. Power Factor : 0.85 (lagging)

c. Frequency : 50 Hz

Note : Bidder shall use Hydrogen/Carbon Relation Ratio under GRI method as per ISO/TR 22302:2014(E) for calculating the Methane number for deciding reference point of correction curve as well as for calculating the Methane number of supplied gas during Performance guarantee test. Bidder shall necessarily submit the calculation of reference methane number as mentioned above along with the bid.

3.01.02 Guaranteed performance at above mentioned reference conditions shall be without any output enhancement measure.

3.01.03 The Bidder shall indicate in his Offer all the Performance Guarantees specified in Volume – V, Part A, Section VI as part of “Functional Guarantee Schedule”.

3.01.04 Design cooling water temperature shall be decided by the Bidder based on ambient dry bulb temperature and RH conditions specified above.

3.02.00 Power output

Output of each Engine /Genset

Gross Output (P_G) of **each Engine /Genset** is defined as follows:

P_G = Continuous output of the Genset as measured at the generator terminals. This power output shall be output of the Genset arrived at by subtracting Power taken by excitation system including its transformer losses, as applicable for guarantee points, in case static excitation system is offered.

Plant gross output shall be calculated by adding gross output of each Engine/genset.

Net Output of Genset

Net Output of Genset shall be as defined below -

$P_N = P_G - P_A$ Where,

P_G = Gross Output of a Genset as defined above

$P_A = P_U + P_C/n$

P_N , P_A , P_U , P_C and n are as given below-

P_N = Net Output of a Genset. Further, Net Plant Power output shall be calculated by summing the net power output of individual engines.

P_A = Auxiliary Power Consumption per Genset

P_U = All unit specific auxiliaries required to run one Genset.

P_C = Power consumption of all common plant auxiliaries and services, excluding the standby auxiliaries/services, for operation of the complete station.

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n= Number of Genset Modules offered.

For arriving Net Power of each engine, all integral and associated auxiliaries of the Genset shall be in service. Further, following common auxiliaries of the plant shall be in service -

- a. Sea water/bore well water intake pumps
- b. Desalination plant
- c. Common cooling water system
- d. Air conditioning, Ventilation & Lighting loads
- e. Compressed air system and Start-up air system
- f. Lube oil purification system
- g. Any other continuously operating equipment/system required for functioning of the Genset.

The Power Consumption of entire common auxiliaries shall be the power consumed by the respective auxiliary at design point as determined during shop test.

In case shop test power consumption for equipment/system mentioned above is not available, then rated power consumption of the equipment/system shall be taken into account while calculating Net Power Output

In case any of the above mentioned equipment/system is not required to be operated during the Performance Guarantee tests, power consumed by the equipment/system shall be taken into account while calculating the Net power output.

3.03.00 Net Heat Rate

Net Heat Rate on LHV basis of a Genset shall be computed as follows:

Guaranteed Net Heat rate of each Genset = [Fuel consumption X Net/lower calorific value of Fuel] ÷ Net power Generation by the Genset.

Where :

Fuel Consumption in SCM/Hour

Net/ lower calorific value of fuel in Kcal/SCM

Power Generation in Kw

LHV of the fuel shall be calculated as per relevant codes and standards. Detail procedure for calculating LHV of the fuels shall be finalized at the time of finalizing Performance Guarantee test procedure.

3.04.00 Correction Curves

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3.04.01 Performance test of each Engine (output & Heat rate) shall be calculated during PG tests at Site. During evaluation of Performance Guarantee Test results, corrections shall be applicable only for following:

- a. Methane Number RLNG fuel
- b. Power Factor
- c. Frequency

Bidder in their bid shall furnish the certified correction curves for above parameters for correcting the Net Output and Net Heat Rate of the each Genset alongwith their Bid documents.

3.04.02 Only certified correction curves, submitted with the Techno Commercial Offer and accepted by the Employer, shall be used for evaluation of Performance Acceptance Test results. Any subsequent submission of performance correction curves shall not be acceptable.

3.04.03 Bidder shall also furnish all such correction curves that may be required either for establishing demonstration guarantees or for performance assessment of individual equipment for the purpose of performance monitoring during operational stage of the plant. List of such curves shall be finalized during detailed Engineering.

4.00.00 MODE OF OPERATION, START UP, GOVERNING MODE, AND PLANT LIFE

4.01.00 Mode of Operation

4.01.01 Each Genset shall be designed to operate as a Base/Full load and Part load generating unit. Genset shall also be suitable for frequent start and stop mode of operation. However, capability to meet the requirements and withstand stresses of cyclic load variations and partial/ full load rejections shall be built in the plant. Specific design features to permit the above operational flexibility shall be provided. Genset units shall be designed to withstand rapid load changes within the frequency band of 47.5 – 51.5 Hz without any restriction.

4.01.02 The Bidder shall clearly bring out in his offer the various design considerations proposed by him to meet the above requirement and ensure that under such operating conditions as given above, no part/ component of the plant shall be stressed beyond the acceptable safe thermal stress and fatigue levels to get a life of 25 years for the plant.

4.01.03 All equipment, including Engine and Generators/Alternators shall be designed to withstand frequency variation in 47.5 – 51.5 Hz frequency range. Bidder shall indicate the period of operation of Gensets permitted during the life of the plant for operation beyond the frequency range of 47.5 - 51.5 Hz.

4.01.04 Start-up criterion for Genset Module

- (i) Each Genset shall be capable of delivering its full rated output within 5 minutes from Stand-by hot condition (meeting the pre-set Lube oil temperature, Cooling water temperature & Start-Up air pressure as per Engine OEM standard requirements). Start-up command to the Engine Module shall be considered as datum on the time scale.
- (ii). Gensets shall be capable of absorbing the transitory temperature gradients after rapid start and immediate restart. It shall be possible to start and synchronize

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Genset units at any grid frequency within the frequency band of 47.5 - 51.5 Hz without any restriction.

4.01.05 All Equipment/ Systems shall be designed to provide flexibility in operation as specified. The Bidder should clearly bring out in detail the 'Plant Operation Philosophy' proposed for the entire plant meeting the above requirements. In order to enable the Employer to verify the above, the 'Plant Operation Philosophy' shall include write-ups for following:

- a. Genset Module Start-up (including preparations) –different start up modes as per standard proven practice of OEM
- b. Base Load and Part Load operation
- c. Load Rejection
- d. Genset Module Shutdown
- e. Prolonged outage (lay-off)

Important operational aspects and limitations (if any) to be considered during each of the above mentioned operating regimes shall be furnished.

4.02.00 Plant Life

4.02.01 The plant shall be designed for a minimum operating life of 25 years for the operating capabilities and duty specified in these specifications. Bidder shall confirm in his offer that all plant components are designed adequately for this lifetime. If there are any items of the plant on which this lifetime cannot be confirmed, the life of such items and the reasons for the same shall be stated in the offer.

4.02.02 Plant Maintenance during Commissioning/Initial operation Period and subsequent O&M period

- (i). The Contractor shall ensure presence of Genset OEM's experts during all scheduled and unscheduled inspections, without prejudice to the contractor's liabilities in terms of other provisions under the Contract including guarantees and post-commissioning services. Contractor shall be responsible for all scheduled and un-scheduled inspections and maintenance activities of the complete plant. The Contractor shall be responsible for all expenses towards services and materials required for all such Inspections and repairs/replacements.
- (ii) Operation and Maintenance of the complete plant shall be under contractor's scope for a period of 03 years after Initial Trial operation and Take-over of the plant. Contractor to ensure minimum 90% availability of the plant for the said O&M contract period. Contractor shall be responsible for all expenses towards services, materials and any other associated cost required during above period.

Owner/Client shall only be responsible for the availability of Fuels within the plant premises during above period.

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4.03.00 Capabilities for variations in Ambient/ Operating and Fuel Properties

4.03.01 The Plant shall be designed for trouble free and reliable operation within the following range of operating and ambient conditions:

	Design Reference	Range of Variation
Ambient Temp. (DBT)	28 °C	14.6 to 36.1 °C
Barometric Pressure	1001.8 mbar	996.9 to 1014 mbar
Relative Humidity (RH)	80 %	65 % to 100 %
Grid Frequency	50 Hz	47.5 to 51.5 Hz

Other variations indicated in Project Information and specified in Technical Specifications (Part B) shall be duly considered in the overall design of the plant.

4.03.02 Design and sizing of Engines, Electric Generators/Alternators, Cooling Systems, various mechanical and electrical auxiliaries and other balance of plant (BOP) equipment shall be not be constraint, whatsoever, for achieving the 100% base/full load output at all conditions within the specified range of operating conditions.

4.03.03 RLNG composition range indicated in Project Information (Annexure-IA, Volume – II, Part A) is the fuel. Engine and support systems shall be designed and sized to accept RLNG of any composition within the specified range. Equipment/ systems required to provide the above flexibility is included in Bidder's scope of supply.

4.04.00 Reliability, Availability and Maintainability

4.04.01 Design, Redundancy, Plant layout and Maintenance Practices in respect of all the components of the plant shall be such as to achieve good Reliability, Availability and Maintainability throughout the Plant Life.

4.04.02 Redundancy level in plant equipment and systems shall be such as to support operation of the plant in all specified modes of operation. Where redundant (standby) equipment is provided, the standby equipment shall be capable of automatic and immediate initiation in to operation upon failure of one or more of the running equipment. Necessary instrumentation and controls to sense the failure of running equipment and initiation of standby equipment shall be provided.

4.04.03 The Bidder shall indicate in his offer the expected figures for Reliability and Availability for power plant as whole and major equipment like Engines & Generators/Alternators and substantiate the same by actual experiences at running installations. Further, the Bidder shall necessarily include in his offer the Inspection/ Maintenance Guidelines for Engines, Generators/Alternators, pumps, motors and other associated equipment installed in the plant to ensure min. 90% plant availability.

4.04.04 The Contractor shall establish the specified Availability of Plant as part of Performance Guarantee Tests as stipulated in Volume – V, Part A of Section - VI.

4.05.00 Design requirements for conductance of Periodic Performance Tests

In addition to the initial Acceptance Tests to be conducted by the Contractor, the Employer/O&M Contractor would be conducting periodic Performance Tests for Gensets

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and their associated individual equipment/ systems. The Bidder shall duly consider the requirements for instrumentation accuracy (as per applicable test codes), recalibration requirements of on-line Instruments, location of plant instrumentation (to be used for testing) and provision for installation of temporary test instrumentation and design the systems and equipment accordingly.

5.00.00 CYCLE REQUIREMENT AND DESIGN CRITERION OF POWER PLANT EQUIPMENT

5.01.00 General

5.01.01 The offered plant shall be complete in all respects for safe and reliable operation for the operating regimes and duty conditions specified. Considering the conditions particular to the site e.g. coastal location, high humidity round the year and heavy rainfall, necessary design attention shall be given to protect the installation against corrosion and mitigate the effect.

5.01.02 All Gensets shall be identical to each other in respect of performance, sizing, equipment design and interchangeability of equipment and subassembly or component of an equipment.

5.01.03 Each Genset shall be independent in all respects i.e. part or full outage of a particular Genset shall not hamper trouble free sustained operation of the remaining Gensets in any way, whatsoever.

5.01.04 The design criterion specified here in the following paragraphs pertains to the project specific requirements in respect of sizing and configuration. Equipment specification shall be as per respective chapters of Part – B, Section – VI.

5.02.00 Genset & Support Systems

5.02.01 Gensets shall be capable of trouble free and sustained continuous operation at all ambient and operating conditions specified.

5.02.02 The plant site is in the close vicinity of sea, accordingly Air Intake Filtration System of Engines and all other equipment shall be designed to ensure that maximum level of NaCl in the treated air does not exceed the maximum allowable value i.e. permissible fuel equivalency value. Airborne salt concentration shall be considered as typical for a tropical coastal location for the climatological conditions specific to the plant site.

Further, the complete system of the power plant shall be designed to withstand local climate conditions (plant located close vicinity of sea) and other climatic conditions specific to the site.

5.02.03 The design philosophy of all the Genset auxiliaries shall be as per the standard proven practices of the Original Equipment Manufacturer (OEM) of Genset & all drawings/ documents shall be vetted by the Genset OEM during execution stage

6.00.00 ENVIRONMENTAL REQUIREMENTS

6.01.00 Noise Levels

The noise levels shall meet the MoEF&CC guidelines as enclosed at Annexure-IA of Volume-IV, Part-A, Section-VI.

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6.02.00 NOx Emission Limits

6.02.01 The Guaranteed NOx level (on dry volume basis corresponding to 15% excess oxygen in flue gas) for each Engine shall be as follows:

RLNG - less than 80 ppm

Above specified guaranteed NOx emission level for each Engine shall be demonstrated at different loads varying between 50% and 100% of the design output rating of the Engine at specified site reference conditions.

Emission shall meet the standards notified for NOx from Gas/ Naphtha Based TPP published vide notification dated 22.12.1998 by MoEF under E (P) Rules.

6.02.02 NOx guarantee shall be for the Total NOx which is defined as summation of NOx formed by Oxidation of atmospheric nitrogen in the combustion air (thermal NOx + prompt NOx) and NOx formed from the nitrogen chemically bound in the fuel (FBN). If the fuel specification given in Project Information Chapter does not indicate FBN, typical representative value shall be suitably considered by the Bidder and shall be indicated in the Offer.

6.02.03 NOx Control equipment shall be designed to achieve the above specified NOx level in all ambient conditions specified.

6.02.04 Online NOx, SOx, CO, CO₂, Particulate matter and NMHC monitoring of exhaust gas at each stack outlet shall be provided.

6.03.00 Liquid Effluents

6.03.01 All liquid effluents emanating out of the power plant shall be treated (as required) to meet the Environmental Standards for Gas Naphtha-based Thermal Power Plants published by MOEF vide notification dated 22.12.1998 and General Standard for Discharge of Environment Pollutants, Part-A: Effluents Published by MOEF dated 19.05.93 & also the latest MoEF&CC notification for discharge standards for effluents dated 13.10.2017 under E(P) Rules & its amendment thereof, applicable for discharge in Inland Surface Waters, whichever are more stringent.

The discharge standards to be followed are enclosed at Annexure-II (A) & Annexure-II (B). The treated effluents shall also meet quality requirements of CPCB, if more stringent than the standard mentioned in technical specifications.

6.03.02 Devices for measurement of pH, Turbidity, Conductivity, and Flow at the point of liquid effluent discharge out of the plant shall be installed.

7.00.00 FUEL HANDLING SYSTEM

7.01.00 Gaseous Fuel Handling System

7.01.01 RLNG is envisaged as fuel for the project. Properties of the gaseous fuel envisaged for the project is indicated in Project Information, Part-A, Volume-II, Section-VI of Technical Specification. Employer shall arrange the gas within the premises of power plant. Bidder shall connect the gas supply line with incoming line terminated inside the plant boundary.

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Further, Bidder shall ensure the gas parameters and quality as per the requirement of his engines. Any modifications/equipment/systems required to meet the gas parameters and quality shall be under bidder's scope.

8.00.00 DESIGN CRITERION FOR PIPING SYSTEMS

8.01.00 Design, fabrication, assembly and testing of pipes, fittings, flanges, piping components, valves and specialties, thermal insulation, etc. shall generally conform to the requirements of ASME B 31.1 and other relevant ASME standards.

8.02.00 Design basis for 'Piping' shall be as per Part B of Technical Specification.

8.03.00 All over ground pipes (Cooling Water, gaseous fuel, fire-fighting etc.) shall be provided with suitable protection against the corrosive coastal atmosphere.

9.00.00 Fire Detection and Protection System

9.01.00 General Design Criteria

- i) The fire protection system shall consist of fire water storage tanks, fire water pumping system, fire water hydrant and spray system serving the whole station including plant/facilities/ buildings.
- ii) All major equipment/ system components in the entire fire protection & detection system shall have the approval from one of the following:
 - a) Underwriters Laboratories of USA
 - b) LPCB –UK
 - c) VDS
 - d) BIS (for the approval of pumps and valves)
 - e) FM - USA

However, design and installation of complete system and requirements shall be approved by TAC accredited professional(s)-India.

- iii) Any other additional equipment not specifically mentioned in the technical specification but are found necessary to meet the requirements of TAC and also for safe and sound operation of the plant are to be included at no extra cost to Employer.

9.02.00 Hydrant System

Design philosophy (minimum requirement)

- i) Category of Hazard and minimum terminal pressure shall be as per TAC norms.
- ii) At least two hydrant ring mains shall be provided. Separate ring main for the main plant (including transformer yard) to be provided. Isolation valves (gate valves) between various ring mains shall be provided so that ring mains can be interconnected and water from any of the ring main can flow to other mains.
- iii) At locations where water cannot reach through ground level hydrants, water monitors at required intervals shall be provided. In addition to above fire hydrant to be provided at 45 Mtr. Risers for these hydrant valves shall be supported Further, fixed water monitors shall also be provided where elevation having elevation 20M or more.

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- iv) All the landings various building and other multi storied structures of the plant shall be provided with hydrant landing valves. Further, Gate Valve shall be provided as isolation valve in each riser of internal hydrant system.
- v) Each of the landing valves and external hydrant valves associated with the main plant, switchyard & transformer areas and other areas/building shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc. as per TAC guidelines.

For landing valves of various buildings, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines.
- vi) The pipelines routed in RCC trenches shall be provided with coating and wrapping. Road, Rail or pipe trench crossing be through trestle/RCC hume pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification.

9.03.00 HVW & MVW Spray System

Design Philosophy (Minimum Requirements)

- i) Design discharge density shall be as per the rules of TAC and/ or NFPA standards.
- ii) Deluge valve along with trims like pressure gauge, water motor gong, etc. shall be UL/FM or equivalent approved / listed. The deluge valve (auto resetting type) assembly shall consist of accessories such as water motor gong, alarm test valves, drip/drain valves, strainers for these valves, hydraulic releasing system, solenoid valves, etc. Further, the design features and make of all the projectors / spray nozzles shall be UL/FM or equivalent approved / listed.
- iii) A strainer ('Y' type) be provided at upstream of deluge valve. Each deluge valve shall be provided with isolation gate valves (with limit switch) upstream & downstream.
- iv) Pressure switches be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock.
- v) Wet type pipe detector network shall be provided for spray system using quartzoid bulb detectors.
- vi) Each of the outdoor deluge valve and accessories shall be provided with housing.
- vii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel through the keyboard operation of PC monitoring station when the system is selected in remote manual mode. The remote manual selection for the operation of spray system on any equipment or any zone shall also be through the monitoring station of the respective panel. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel.

9.04.00 Not Used

9.05.00 Fire Detection, Alarm and Control System Design Philosophy (Fire Alarm and Detection System)

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- i. The PLC based panel at fire water pump house shall indicate the status of each pump, system pressure, operation of hydrant and/ or spray system, failure of starting of pumps, healthiness & failure of batteries/ chargers, main supply, low level of fuel oil of diesel engines, tripping of pumps, low level / very low level of water in the water supply system, status of batteries & chargers of panels and diesel engines etc. Alarms from these panels shall also be available to operator at fire alarm addressable panels, central monitoring station and DDCMIS.
- ii. The addressable type panels at Control equipment rooms shall receive signal from sensors from various areas/ equipments of the respective units.
- iii. The central monitoring station to be located at Central Control Room shall cover the fire detection and protection system of the complete (all the areas) plant. This shall give audio-visual annunciations for fire in each of the risk area / equipment / status of the fire protection system as well as system operator open / short circuit status of detector or control cabling, etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system.
- iv. Alarms from all the panels shall be repeated simultaneously in repeater panel at Fire station.
- v. The addressable panel shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to prearranged points, supervise and monitor the complete fire detection & extinguishing circuits, initiate control functions like shutdown of draft fans, air-conditioning and ventilation plant/equipment, closure of Fire dampers in A/C & Ventilation system etc. Opening smoke extraction vents, switching on smoke extraction equipment emergency lighting, tripping of transformer lockout relays etc.
- vi. All the circuits from the detectors to the panels and the circuits from the panels to the actuating devices (such as solenoid valves, deluge valves, push buttons etc.) shall be closed loop type and shall be supervised for open and short circuiting. The trouble signal also be annunciated in the respective panels.
- vii. Facilities shall be provided on the fire alarm panel for simulating fire conditions, sensitivity adjustment, isolation of detectors etc. from the panel.

9.06.00 **Total Flooding Inert Gas Extinguishing System**

9.06.01 **Design Philosophy (Minimum Requirements)**

General

- a) Complete design and all critical components / equipment like cylinder, cylinder valve assembly, hoses, check valve, actuation controls, restrictor/pressure reducer, directional/selector valve, pressure relief device/safety valve, pressure gauge, pressure switch, nozzle, etc. shall be approved and listed by UL/FM /VDS /LPCB or equivalent and the system shall also be approved by TAC accredited professional(s) before installation.

Basic design parameters of inert gas extinguishing system like type of inert gas agent, extinguishing/design concentration, safety factor, discharge time, etc. shall be considered in strict accordance with NFPA-2001 (latest edition). Piping design/layout, nozzle arrangement/orientation, etc. shall confirm to UL/FM/VDS/LPCB or equivalent.

Agent Supply, Design Concentration, Quantity & Discharge time

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- a) System shall be designed to meet the minimum requirements of total flooding inert gas extinguishing system as per NFPA 2001. However higher concentration may be used if it is specified by the agent manufacturer/ system supplier for the area protected.
- b) The complete volume of the rooms including the above false ceiling shall be considered for estimation of quantity of gas and containers.
- c) When determining the gas quantity, the leakage losses from the enclosure shall be taken into account by the supplier. Further volume of re-circulating type air conditioning system & its duct work (atleast upto the automatic fire dampers of the ducts) shall be considered as a part of the total volume so that the design concentration is achieved throughout the hazard area. Further gas quantity shall be adjusted for ambient pressure & temperature conditions. Bidder to provide primary supply of gas & its cylinders, along with 100% (one hundred percent) standby / reserve gas quantity and cylinders for each room/area.
- d) However, if the system design permits provision of a common "ENGINEERED STORAGE SYSTEM" with directional valves for multiple rooms / areas of one unit, such a design is acceptable provided the total primary supply and/or reserve supply is equivalent to the requirement of largest area / room and such rooms /areas are perfectly separated from each other by means of wall / metal cladding or floor of minimum required fire rating. Such common storage system should have been listed & approved by UL/FM/VDS/LPCB or equivalent and bidder should produce documentary evidences for design and installation of such systems elsewhere in the past by them.
- e) In either of the case mentioned in above two clauses, both the main & reserve supply cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy changeover from the panel. Suitable selector switches be provided for "Normal /Standby "supply selection.
- f) The discharge time period shall be such that the design concentration is achieved within time duration specified in NFPA-2001 (latest edition/amendment) The flow calculations shall establish this criteria.
- g) The quality of gas shall conform to relevant design standard such as NFPA – 2001(latest edition) or as specified by listing authorities.

Storage containers

- a) The storage cylinders offered shall be of seamless type & brand new. Welded cylinders are not permitted.
- b) All the storage containers shall be provided under an enclosure. It shall not be kept open to atmosphere.
- c) The storage containers shall be securely installed as per the listed installation manual with a provision for convenient individual servicing and container weighing. Such servicing or weighing shall be possible without shutting down the system.
- d) Automatic means such as check valves shall be provided to prevent gas loss if the system is operated when any containers are removed for maintenance.
- e) The storage containers shall not be charged to a fill density or super pressurization level different from the manufacturer's listing.
- f) The design pressure for storage cylinders shall be suitable for the maximum pressure developed at 55 degC and shall be designed to meet the requirements in NFPA-2001.

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- g) All cylinders shall bear the marking as detailed out in NFPA -2001 and shall be duly listed by UL / FM /VDS/LPCB or equivalent in addition to approval by Chief Controller of Explosives - INDIA.
- h) The storage cylinders shall have accessories such as pressure gauges/ switches, liquid level indicators (if applicable), refilling connections, relief devices (if applicable) etc. A reliable means of indication other than weighing shall be provided to determine the pressure in cylinders.
- i) All the pressure gauges/switches, manifold connections etc. shall be easily removable for servicing / maintenance without any loss of gas.

DISTRIBUTION

- a) Both main & reserve cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy & auto changeover. Cylinder Manifold, directional valve manifolds, Piping, fittings & pressure relieving device shall be designed for the maximum design pressure of the system and shall conform to the requirements of NFPA -2001 (latest edition) or as specified by listing authorities. Material of construction for manifolds shall be as per listed design manual and shall be hydro-tested as per design manual or at 1.5 times the maximum design pressure, whichever is higher.
- b) Discharge nozzles along with deflector shields shall be listed for the intended use including the flow characteristics and area of coverage and quantity & design shall be such that complete quantity of gas is uniformly distributed throughout the hazard volume within the specified discharge time without disturbing the ceilings, lighting fixtures etc.
- c) The fire detection system to be employed shall be as specified elsewhere. Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers. Power supply be taken from the Fire detection /alarm system panels of the respective units. Required annunciations such as "Gas released", "Failure of automatic actuation" etc shall be exhibited in the fire alarm panel.
- d) Where pilot cylinders are employed for actuation of the cylinder banks, the number of pilot cylinders shall be as per the listed design manual.
- e) Facility for manual release of gas through push buttons be provided along with selection facility of "Auto/Manual" from the panel.
- f) In addition to this, local manual release through lever operation shall also be provided near the cylinder banks.
- g) All manual-operating devices shall be identified to the hazard they protect by fluorescent paint.
- h) Manual abort switches shall be provided for each of the area/zone and the same shall be provided as per NFPA -2001 or as specified by listing authorities.
- i) The gas releasing devices at cylinder outlets shall be of re-usable type after discharge at any instant.
- j) Supervision of automatic actuation devices, power supply, manual actuation circuits, and complete wiring shall be provided through control system /panel and the healthiness shall be reported or indicated in the panel automatically. Complete control system shall be listed and approved by UL/FM/ VDS/LPCB.

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Design, Installation & Testing

- a) System design, specifications, working plans, flow calculations etc shall be prepared in line with the NFPA-2001 or as specified by listing authorities and shall be approved by Employer. The system flow calculations shall be performed using a calculation listed or approved by UL/FM /VDS/LPCB.
- b) Calculation shall be provided by the designer to prove that the area is not pressurized and extinguishing capability is not affected due to provided ventilation of that area. Bidder to provide additional ventilation arrangement if required.
- c) After installation, the complete system shall be inspected and tested as per the recommendations of Chapter-4 & relevant Clauses of Appendix-A of NFPA-2001. Wherever testing is mentioned at a regular frequency in these chapters, the bidder shall carry out initial testing and records shall be presented to Employer for approval of the installation.
- d) Prior to handing over of the system to Employer, the supplier shall provide operational training to Employer's operating personnel which shall consist of control system operation, trouble procedures, emergency procedures, safety requirements etc.
- e) The complete installation, testing, commissioning & training shall be carried out by the Contractor under the supervision of the Manufacturer/ designer at site.
- f) The performance test of the system shall be carried out by releasing the agent gas in a selected area and design parameters shall be measured. All equipment, refilling of gas after test, instruments etc. shall be provided by the contractor for the same.

SAFETY

- (a) All the safety requirements recommended in NFPA -2001 or as specified by listing authorities shall be incorporated in the installation by the bidder.
- (b) Appropriate warning signs shall be fixed outside of those areas protected by the system and also in areas where the gas may spread indicating clearly the hazard associated with the system such as Noise, turbulence, cold temperature, physiological effects on personnel etc.
- (c) Apart from written warning signs, audio-visual type warning signs (i.e) hooters & strobe lights shall be provided for pre-discharge and post-discharge activity. The sounder shall have selectable tone options.
- (d) The gas shall be discharged after a set time delay on receiving signal from the fire detection system. The duration of the timer shall be upto a range of 0- 5 minutes (adjustable in 1 minute variation) at site after conducting test to find out the duration for evacuation of the personnel from the area.
- (e) To prevent the loss/release of gas automatically or manually during maintenance, the system shall have the facility of "LOCKOUT". The status of the system lockout condition shall be annunciated audio-visually in the panel.

Pressure Venting

Since huge quantity of gas is envisaged to be released, proper pressure relief and ventilation systems such as fans, dampers, etc. shall be provided by the contractor. Required openings in the civil structure shall be provided by the owner. The contractor shall submit pressure relief, venting calculations, its requirement and suggestive mode of ventilation during detailed engineering for approval.

10.00.00

AIR CONDITIONING AND VENTILATION SYSTEM

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10.01.00 DESIGN PHILOSOPHY - Air conditioning system

1. Design ambient conditions for all air conditioning system shall be as indicated below:

Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Dry	38	33.8
Rainy	32	30.6

2. All equipments of Air Conditioning system shall be designed for continuous duty.
3. All air conditioned areas like control room, control equipment rooms, office room, meeting/conference room, shift in-charge room, etc. shall be maintained at 24 deg. C $\pm$ (plus or minus) 1 deg. C and relative humidity of 50% $\pm$ (plus or minus) 5%.
4. The fresh air quantity for air-conditioned areas of Control Room / Control Equipment Room / UPS, etc. shall be 0.45 M³/minutes/person or 1.0 air change per hour whichever is greater. However, for other areas quantity of fresh air shall be minimum 1.5 air changes per hour.
5. Lighting load shall be minimum 2 Watts/Sq.feet or actual whichever is higher.
6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room the same shall be one per 3 Sq.M. In the control rooms, control, equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum).
7. In Air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided.
8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts shall be provided in control panel of A/C by the Contractor for further wiring upto fire alarm panels.
9. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.
10. Requirement of Underdeck Insulation (for A/C area)
11. Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if
- i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.
 - ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.
12. For Packaged Air conditioners serving main plant control area, where microprocessor based equipment are located, the dehumidified air shall be filtered at three different stages i.e. pre (coarse) filter followed by fine filter followed by HEPA filter before discharge it to conditioned space.
13. A minimum design margin of ten (10) % shall be considered in design of AC Plant Capacity for each area. For areas, where A/C load is of the order of 25-60 TR, Direct Expansion (D-X) type air-cooled condensing units alongwith AHUs shall be

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provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 5-25TR, ductable split/package A/C shall be provided. Smaller areas, which are away from the D-X type-condensing unit /central chilling units, which may require air conditioning upto 5 TR rating, shall be served with non-ductable split (Hi-wall/Cassette) air conditioner units as per requirement.

13.1 Refrigerant: Refrigerant should be CFC/HCFC free.

13.2 Insulation for supply and return air ducts: Supply and return ducts shall be insulated.

13.3 All types of Insulation used for HVAC application shall be CFC/HCFC free.

14. During normal operation period, all the working equipment shall run on A.C. power supply. However, in case of complete black-out condition, DG sets being provided are required to cater the load of some of the air-conditioning equipment so that Main Plant Control Rooms and CER remain air-conditioned. The equipment to run on DG set are:

- 1 No. Packaged air conditioner.
- 1 No. Fresh air fan.

10.02.00 DESIGN PHILOSOPHY OF VENTILATION SYSTEM

1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:

- | | | | |
|------|------------------------------------|---|----|
| i) | Main machine hall | - | 30 |
| ii) | General areas | - | 20 |
| iii) | MCC / Switchgear rooms and Battery | - | 30 |

Rooms & other areas where
gaseous fumes/ vapours are generated

2. However in areas producing lot of heat, temperature shall be the criteria as follows:-

- a) Inside Temperature shall be maximum 6 deg.C above the design ambient temperature during summer for mechanically ventilated Engine Hall.
- b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated other areas.

Note : Dry bulb temperature during summer season mentioned at Sl. No. 1 of 10.01.00 (Design philosophy – Air Conditioning System) shall be considered as Design Ambient Temperature for above.

The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected.

3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and/or gravity operated back draft dampers and exhaust fans. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air

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fans / roof exhausters. Supply air fan catering for electrical areas (MCC & Switchgear rooms) shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only.

4. All the equipment of Ventilation system shall be designed for continuous duty.
5. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.

11.00.00 COMPRESSED AIR SYSTEM

DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE

1. All the equipment shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment.
2. The compressors and Air Drying plants shall operate under the following ambient conditions.
 - i. Minimum temperature : 15 deg. C
 - ii. Maximum temperature : 40 deg. C
 - iii. Design condition (temperature & Relative humidity) : 40 deg. C & 85% RH
 - iv. Height above MSL (m) : Refer Chapter "Project Information"
3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.

11.01.00 Selection of Capacity of Air Compressor

11.01.01 Air Compressor for Instrument & Service Air Application:

- i) Air Compressor shall be designed to meet the Instrument air and service air requirement of all the equipments/plant/systems to be supplied by the Contractor for Andaman & Nicobar Gas Power Project as follows:-

Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)
1.	For all Gensets & it's auxiliaries	A
2.	For Water Treatment Plant	B
3.	For C&I System	C
4.	Service air requirement for entire plant	D
		[with D= 2.5 Nm ³ /min (minimum) or as per system requirement]
5.	Total air requirement	= A+B+C+D
6.	Capacity of Air compressor	= 1.3 X (A+B+C+D)

PLANT PERFORMANCE AND DESIGN PHILOSOPHY

Notes:

1. While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirements of instrument air & service air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of instrument air & service air, if any, shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4.
2. The capacity of air drying plant shall be equal to the capacity of the individual air compressors. The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air".
3. Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.0 Kg/cm² (g) or more as per the requirement of Contractor.
4. The discharge pressure of compressor shall be minimum 8 Kg/cm²(g).
5. The heat exchangers are air cooled.
6. Noise level shall not exceed 90 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level.
7. Parallel operation of compressors shall be possible without any undue vibration and noise.
8. The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors.
9. The EOT crane in machine hall shall be used for the operation or maintenance of air compressors.
In case the air compressors are not in approach of the EOT crane, separate monorail beam with electric hoist shall be provided for handling air compressors.
10. All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg. C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.

12.00.00 CONTROL & INSTRUMENTATION

Detailed requirements on C&I design philosophy to be followed for the project, same shall be as per Part-B, Section-VI of the Technical Specifications.

13.00.00 ELECTRICAL

Detailed requirements on electrical design philosophy to be followed for the project, same shall be as per Part-B, Section-VI of the Technical Specifications.

14.00.00 DESIGN CRITERIA FOR BALANCE OF PLANT (BOP) SYSTEMS

Detailed requirements on BOP systems design philosophy to be followed for the project, same shall be as per Part-B, Section-VI of the Technical Specifications.

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15.00.00 PROVENNESS OF EQUIPMENTS/SYSTEMS

The bidder/its sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for the items/ services listed below as per the stipulated criteria indicated in the respective clauses..

15.01.00 DELETED

15.02.00 Main plant auxiliaries and balance of plant equipment/ systems:

The bidder/ his sub-vendor(s) is required to meet the provenness criteria for equipment(s) / system(s) and bought out items as per the criteria stipulated below.

15.02.01 The following equipments offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration/Licensing agreement), manufactured/got manufactured the respective equipment(s) of the type and the minimum equipment rating as stipulated below such that the respective equipment should have been in successful operation for a period of at least one (1) year on or before Six (6) months after award date of Andaman & Nicobar Gas Power project package.

S. No.	Name of Equipment/system	Type/Detail of Equipment/system	Equipment Rating
Gas Engine Auxiliaries and Support Systems			
1.	Starting air system	Starting air compressor and air receivers	As required for the offered RLNG fired fuel Engine.
2.	Engine lub oil system	Engine main lube oil pump, pre-lub oil pump & lub oil filter	As required for the offered RLNG fired fuel Engine.
3.	Engine Cooling System	Engine cooling pumps & radiator cooling package	As required for the offered RLNG fired fuel Engine.
4.	Exhaust gas system	Gas silencer, Expansion bellows & rupture disc on exhaust ducting	As required for the offered RLNG fired fuel Engine.

15.03.00 Not Used

15.04.00 Fire Detection and Protection System:

The bidder/its sub-vendor should have designed, supplied, erected and commissioned at least one (1) Fire protection System of contract value not less than INR 35.0 million or equivalent in foreign currency (exchange rate applicable as on date of Techno-commercial bid opening), in industrial installation. The fire protection system should have comprised of:

- Fire hydrant system.
- High velocity water (HVW) spray or medium velocity water (MVW) spray or sprinkler system.
- Fire water pumping and pressurizing arrangement.

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The system mentioned above should have been designed to the recommendations of Tariff Advisory Committee of India or Oil Industry Safety Directorate (OISD) or any other International reputed authority (like LPC-U.K. or NFPA, USA) and this system should have been in successful operation for a period of not less than one (1) year on or before Six (6) months after award date of Andaman & Nicobar Gas Power project package.

In addition, the analogue addressable type fire alarm system proposed to be supplied shall be sourced from a firm who has supplied at least one (1) similar system which has been approved or listed by UL-USA/ FM-USA / LPC-UK/ similar agency and should have been in operation for at least one (1) year on or before Six (6) months after award date of Andaman & Nicobar Gas Power project package. Further, the inert gas fire extinguishing system shall be sourced from agency who has designed and supplied at least one (1) inert gas total flooding fire extinguishing system each having a total risk volume of at least 500 cum. This system must have been designed to the recommendation of Tariff advisory committee of India or any other international reputed authority (like LPC-UK or NFPA, USA) and should have been in operating condition for a period not less than one (1) year on or before Six (6) months after award date of Andaman & Nicobar Gas Power project package.

15.05.00 Compressed Air System:

The bidder/its sub-vendor should have designed, manufactured, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number non-lubricated oil free screw type air compressor of minimum capacity 10 NM³/min at rated discharge pressure of 8 kg/cm² (g) which should have been in successful operation for at least one (1) year on or before Six (6) months after award date of Andaman & Nicobar Gas Power project package.

The Air Drying Plant (A.D.P) shall be supplied from such manufacturers who have manufactured and supplied at least one (1) number Air Drying Plant of capacity 10 Nm³/min or more and the type same as offered, which should have been in successful operation.

15.06.00 ELECTRICAL EQUIPMENTS:

15.06.01 Generator:

The offered synchronous generator (alternator) shall be from such a manufacturer who has manufactured and supplied synchronous generator of offered MW rating or above rating, which should have been in successful operation in at least one (1) plant for a period not less than one (1) year on or before Six (6) months after award date of Andaman & Nicobar Gas Power project package.

15.07.00 PROVENNESS CRITERIA FOR CIVIL & STRUCTURAL WORKS:

15.07.01 Bidder or his agency should have in past executed civil and structural works for industrial building with Electrically Operated Travelling Crane including earthwork in filling involving mechanical compaction, machine foundations.

15.07.02 For chimney/stack, Bidder or its agency should have in the past built atleast one (1) chimney/stack of height not less than 80% of the required height.

15.07.03 Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them.

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15.08.00 SOLAR PV ROOFTOP ON PLANT BUILDINGS:

15.08.01 Solar PV rooftop EPC contractor:

The Bidder or its Sub-vendor should have designed, supplied, erected/supervised erection and commissioned/supervised commissioning of SPV based grid connected power plant of at least one plant of 40 kWp or above. The reference plant of 40 kWp or above capacity must have been in successful operation for at least six months.

15.08.02 Solar PV Module:

The bidder/sub-contractor shall meet the requirements as stipulated in para (a) and (b) below for supply of solar PV modules:

a) The Bidder / sub-contractor should have manufactured and supplied the solar PV modules of cumulative installed capacity of 1MWp or above using any rating of modules and any source of indigenous or imported PV cells in any one financial year.

b) The Bidder / sub-contractor should have manufactured and supplied solar PV modules built up using indigenous and/or imported PV cells of power rating 300Wp or above which must have been in successful operation for at least six months

Note: The works referred at clause 15.08.02 (a) & 15.08.02 (b) can be in same or different projects.

15.09.00 Balance equipment's/ systems:

The Bidder at its option can source the balance of plant equipment/systems not covered in clause 15.01.00, 15.02.00, 15.03.00, 15.04.00, 15.05.00, 15.06.00, 15.07.00 & 15.08.00 above. However, for such balance of plant equipment/systems, the Owner reserves the rights to satisfy himself on the provenness of the equipment and capability and capacity of the manufacturers

15.10.00 Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the Bidder/its Collaborators/ licensor/ its sub-contractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.

15.11.00 To enable the approval of sub-vendors, the Bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc.

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ANNEXURE – I (A)

MINISTRY OF ENVIRONMENT AND FORESTS

New Delhi, the 22nd December, 1998

G.S.R.7.- In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986 namely:-

82. Environmental Standards for Gas Naphtha-based Thermal Power Plants.

- (i) Limit for emission of Nox
- (a) For existing units – 150 ppm (v/v) at 15% excess oxygen.
- (b) For new units with effect from 1-6-1999.

Total generation of gas turbine	Limit for Stack Nox emission [(v/v) at 15% excess oxygen]
(a) 400 MW and above	(i) 50ppm for the units burning natural gas. (ii) 100 ppm for the units burning naphtha
(b) Less than 400MW but upto 100 MW	(i) 75 ppm for the units burning natural gas (ii) 100 ppm for the units burning naphtha
(c) Less than 100 MW	100 ppm for units burning natural gas or naphtha as fuel
(d) For the plants burning gas in a conventional boiler.	100 ppm

- (iii) Stack height H in m should be calculated using the formula $H = 14 Q^{0.3}$, where Q is the emission rate of SO₂ in kg/hr, subject to a minimum of 30 mtrs.

- (iv) Liquid waste discharge limit

Parameter	Maximum Limit of concentration (mg/l except for pH and temperature)
pH	6.5-8.5
Temperature	As applicable for other thermal power plants
Free available chlorine	0.5
Suspended solids	100.0
Oil and grease	20.0
Copper (total)	1.0
Iron (Total)	1.0
Zinc	1.0
Chromium (total)	0.2
Phosphate	5.0

83. **Standards/Guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) Sets**

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(C) Guidelines for the manufacturers/users of DG sets (5 KVA and above).

- 01 The manufacturer should offer to the user a standard acoustic enclosure of 25 dB(A) Insertion Loss and also a suitable exhaust muffler with Insertion Loss of 25 dB(A).
- 02 The user should make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper siting and control measures.
- 03 The manufacturer should furnish noise power levels of the unsilenced DG sets as per standards prescribed under (A).
- 04 The total sound power level of a DG set, at the user's end, shall be within 2 dB(A) of the total sound power level of the DG set, at the manufacturing stage, as prescribed under (A).
- 05 Installation of a DG set must be strictly in compliance with the recommendations of the DG set manufacturer.
- 06 A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.
- 07 Temperature Limit for Discharge of Condenser Cooling Water from Thermal Power Plant.

A New thermal power plants commissioned after June1, 1999.

New thermal power plants, which will be using water from rivers/lakes/reservoirs, shall install cooling towers irrespective of location and capacity. Thermal power plants which will use sea water for cooling purpose, the condition below will apply.

B New projects in coastal areas using sea water.

The thermal power plants using sea water should adopt suitable system to reduce water temperature at the final discharge point so that the resultant rise in the temperature of receiving water does not exceed 7°C over and over the ambient temperature of the receiving water bodies.

C Guidelines for discharge point :

1. The discharge point shall preferably be located at the bottom of the water body at mid-stream for proper dispersion of thermal discharge.
2. In case of discharge of cooling water into sea, proper marine outfall shall be designed to achieve the prescribed standards. The point of discharge may be selected in consultation with concerned State Authorities/NIO.
3. No cooling water discharge shall be permitted in estuaries or near ecologically sensitive areas such as mangroves, coral reefs/spawning and breeding grounds of aquatic flora and fauna.

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Annexure –II (A)

GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS

PART- A: EFFLUENTS

(Published vide MOEF Notification dated 19.05.1993 under Env. (Protection) Rules, 1986 and amended vide Notification dated 31.12.1993)

Sl. No.	Parameter	Standards			
		Inland surface water	Public sewers	Land for irrigation	Marine coastal areas
	2	(a)	(b)	(c)	(d)
1.	Colour & odour	All efforts should be made to remove colour and unpleasant odour as far as practicable	-	All efforts should be made to remove colour and unpleasant odour as far as practicable	All efforts should be made to remove colour and unpleasant odour as far as practicable
2.	Suspended solids mg/l, Max.	100	600	200	(a) For process waste water- 100 (b) For cooling water effluent 10 per cent above total suspended matter of influent.
3.	Particle size of suspended solids	shall pass 850 micron IS Sieve	-		(a) Floatable solids, max. 3mm. (b) Settleable solids max 850 micron.
4.	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5.	Temperature	Shall not exceed 5°C above the receiving water temperature.	-	-	Shall not exceed 5°C above the receiving water temperature.
6.	Oil and grease mg/l Max.	10	20	10	20
7.	Total residual chlorine mg/l Max.	1.0	-	-	1.0
8.	Ammoniacal nitrogen (as N) mg/l max.	50	50	-	50

PLANT PERFORMANCE AND DESIGN PHILOSOPHY

Sl. No.	Parameter	Standards			
		Inland surface water	Public sewers	Land for irrigation	Marine coastal areas
	2		3		
		(a)	(b)	(c)	(d)
9.	Total Kjeldahl nitrogen (as N); mg/l Max.	100	-	-	100
10.	Free ammonia (as NH ₃) mg/l, Max.	5.0	-	-	5.0
11.	Biochemical oxygen demand (5 days at 20°C), mg/l Max.	30	350	100	100
12.	Chemical oxygen demand mg/l Max.	250	-	-	250
13.	Arsenic (as As) mg/l Max.	0.2	0.2	0.2	0.2
14.	Mercury (as Hg), mg/l Max.	0.01	0.01	-	0.01
15.	Lead (as Pb) mg/l, Max	0.1	1.0	-	2.0
16.	Cadmium (as Cd) mg/l, Max	2.0	1.0	-	2.0
17.	Hexavalent chromium (as Cr+6) mg/l, Max	0.1	2.0	-	1.0
18.	Total chromium (as Cr) mg/l, Max	2.0	2.0	-	2.0
19.	Copper (as Cu) mg/l, Max	3.0	3.0	-	3.0
20.	Zinc (as Zn) mg/l, Max	5.0	15	-	15
21.	Selenium (as Se) mg/l, Max	0.05	0.05	-	0.05
22.	Nickel (as Ni) mg/l, Max	3.0	9.0	-	5.0
23.	Cyanide (as CN) mg/l, Max	0.2	2.0	0.2	0.2

PLANT PERFORMANCE AND DESIGN PHILOSOPHY

Sl. No.	Parameter	Standards			
		Inland surface water	Public sewers	Land for irrigation	Marine coastal areas
	2		3		
		(a)	(b)	(c)	(d)
24.	Fluoride (as F) mg/l, Max	2.0	15	-	15
25.	Dissolved phosphates (as P) mg/l, Max	5.0	-	-	-
26.	Sulphide (as S) mg/l, Max	2.0	-	-	5.0
27.	Phenonic compounds (as C ₃ H ₃ OH) mg/l, Max	1.0	5.0	-	5.0
28.	Radioactive materials:				
	a) Alpha emitters UC/ml max.	10 ⁻⁷	10 ⁻⁷	10 ⁻⁷	10 ⁻⁷
	b) Beta emitters UC/ml max.	10 ⁻⁷	10 ⁻⁷	10 ⁻⁷	10 ⁻⁷
29.	Bio-assay test	90% survival of fish after 96 hours in 100% effluent.	90% survival of fish after 96 hours in 100% effluent.	90% survival of fish after 96 hours in 100% effluent.	90% survival of fish after 96 hours in 100% effluent.
30.	Manganese (as Mn)	2 mg/l	2 mg/l		2 mg/l
31.	Iron (as Fe)	3 mg/l	3 mg/l		3 mg/l
32.	Vanadium (as V)	0.2 mg/l	0.2 mg/l		0.2 mg/l
33.	Nitrate Nitrogen	10 mg/l	-	-	20 mg/l

Notes:

- Regarding temperature limits for discharge of condenser cooling water from thermal power plants, MOEF vide Notification dated 22.12.1998 has stipulated that all new thermal power plants commissioned after June 1, 1999 which will be using water from river/ lake/ reservoir, shall install cooling towers irrespective of location and capacity.

PLANT PERFORMANCE AND DESIGN PHILOSOPHY

ANNEXURE-II (B)

LATEST MOEF&CC STANDARDS PUBLISHED VIDE GAZETTE NOTIFICATION

DATED 13.10.2017

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 13th October, 2017

G.S.R. 1265(E).—In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:—

1. **Short title and commencement.**—(1) These rules may be called the Environment (Protection) Amendment Rules, 2017.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule – I, after serial number 104 and the entries relating thereto, the following serial number and entries shall be inserted, namely:—

Sl. No.	Industry	Parameters	Standards
1	2	3	4
		Effluent discharge standards (applicable to all mode of disposal)	
“105	Sewage Treatment Plants (STPs)		Location
			(a)
		pH	Anywhere in the country
		Bio-Chemical Oxygen Demand (BOD)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep
			Concentration not to exceed (b)
			6.5-9.0
			20
			Areas/regions other than mentioned above
			30
		Total Suspended Solids (TSS)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep
			Areas/regions other than mentioned above
			<50
			<100
		Fecal Coliform (FC) (Most Probable Number per 100 milliliter, MPN/100ml)	Anywhere in the country
			<1000
*Metro Cities are Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad and Pune. Note : (i) All values in mg/l except for pH and Fecal Coliform. (ii) These standards shall be applicable for discharge into water bodies as well as for land disposal/applications. (iii) The standards for Fecal Coliform shall not apply in respect of use of treated effluent for industrial purposes. (iv) These Standards shall apply to all STPs to be commissioned on or after the 1st June, 2019 and the old/existing STPs shall achieve these standards within a period of five years from date of publication of this notification in the Official Gazette. (v) In case of discharge of treated effluent into sea, it shall be through proper marine outfall and the existing shore discharge shall be converted to marine outfalls, and in cases where the marine outfall provides a minimum initial dilution of 150 times at the point of discharge and a minimum dilution of 1500 times at a point 100 meters away from discharge point, then, the existing norms shall apply as specified in the general discharge standards. (vi) Reuse/Recycling of treated effluent shall be encouraged and in cases where part of the treated effluent is reused and recycled involving possibility of human contact, standards as specified above shall apply. (vii) Central Pollution Control Board/State Pollution Control Boards/Pollution Control Committees may issue more stringent norms taking account to local condition under section 5 of the Environment (Protection) Act, 1986”.			

PART-A

VOLUME – V

GUARANTEES, PERFORMANCE TESTING

&

LIQUIDATED DAMAGES

ANDAMAN & NICOBAR GAS POWER PROJECT (50 MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART A	VOLUME-V GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES	Page 1 of 9
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GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

1.00.00 GUARANTEES

1.01.00 GENERAL

1.01.01 The Bidder shall guarantee that each Genset and other Equipment (for which performance guarantees are applicable) shall meet the various guarantees covered in Technical Specifications.

1.01.02 Functional guarantees to be established by the Contractor are categorized as follows:

Category-I Guarantees : Guarantees, which attract liquidated damages, as indicated under Clause No. 1.02.00 of this volume.

Category-II Guarantees : Statutory Guarantees (Mandatory Guarantees), as indicated in Clause No. 1.03.00 of this volume.

Category-III Guarantees : Demonstration parameters and capabilities, as indicated in Clause No. 1.04.00 of this volume.

1.01.03 For Category I and II Guarantees, the Bidder shall furnish signed declarations in the manner prescribed in the relevant schedule of Forms and Procedures for these Guarantees. Demonstrable parameters for Category – III guarantees shall be indicated in an Annexure to be attached with the Guarantee Schedule.

1.01.04 Category-I Performance Guarantee Tests for each Genset shall be conducted separately. Liquidated damages on account of short fall, if any, in "Guaranteed Plant Performance" shall be levied separately for each Genset as identified in clause 3.00.00, of this Volume. However, Plant availability guarantee shall be applicable for the plant as a whole.

1.01.05 The quoted "Guaranteed Plant Performance", for each of the offered Genset, shall be deemed to include margins required for the error & inaccuracies of test instruments, method of test, human error and any other cause / uncertainties etc. The "Guaranteed Plant Performance" shall mean "Quoted Guaranteed Plant Performance" in the Guarantee Declaration Schedule without any adjustment for the tolerances.

1.01.06 The Contractor shall conduct Performance Guarantee Tests for each Genset to establish that the Quoted Performance Guarantees are met.

1.01.07 The Contractor shall also demonstrate all the specified Category – III guarantees as listed in this Volume during Acceptance Tests or Initial Operation.

1.01.08 The term "Performance Guarantees" shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" shall have the same meaning and shall be synonymous to "Guarantee Tests" or "Acceptance Tests".

1.01.09 The Functional Guarantee Tests shall be carried out on specified fuel, which shall be witnessed by owner/client. Liquidated Damages shall be applicable on shortfall, if any, upon testing.

1.02.00 GUARANTEES ATTRACTING LIQUIDATED DAMAGES (CATEGORY-I)

1.02.01 The bidder shall guarantee and establish following Category – I guarantees for each Genset:

ANDAMAN & NICOBAR GAS POWER PROJECT (50 MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART A	VOLUME-V GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES	Page 2 of 9
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GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

- (i) Net Power Output at Base/Full Load.
- (ii) Net Heat Rate at LHV basis at 100% of Genset base load.

- 1.02.02
- (a) 'Measured Net Power Output' shall be as per IEC and as defined in Clause 3.02.00 of Volume-IV, Part A, Section-VI. Measured Net Power Output shall be corrected for the reference conditions (Clause 3.01.00 of Volume-IV, Part-A, Section-VI).
 - (b) Net Heat Rate as defined in Clause 3.03.00 of Volume-IV, Part-A, Section-VI, shall be computed for 100% Base Load with the Genset. These shall be corrected for the reference conditions (Clause 3.01.00 of Volume-IV, Part-A, Section-VI)
 - (c) Further, no tolerance on the test results will be permitted for the instrument inaccuracy, human error in measurement, method of testing or for any other cause/ uncertainties etc.

Note : Correction shall be applicable as specified under Cl. No.3.04.00 of Vol IV, Part-A, Section-VI

- 1.02.03
- In case the contractor is not able to demonstrate the above mentioned "Guaranteed Plant Performance" even after the modifications or replacements within ninety (90) days of notification by the Employer, the Employer at his discretion will take actions as follows:

- a). Net Output within (-) 2.5 % of the Guaranteed Net Power Output. : Accept the equipment/ system after levying Liquidated Damages for the shortfall from the quoted Guaranteed Net power Output, as per Clause No.3.00.00 of this Volume.
- b). Net Output beyond (-) 2.5 % of the Guaranteed Net Power Output. : At its discretion may either accept the equipment/ system after levying Liquidated Damages for the shortfall from the quoted Guaranteed Net Power Output, as per Clause No. 3.00.00 of this Volume or reject the equipment/ system and recover the payment already made.
- c). Net Genset heat rate at 100% of Genset base load within (+) 2 % of the Guaranteed Net Genset Heat Rate at 100% of the base load. : Accept the equipment/ system after levying liquidated damages as defined in clause no. 3.00.00 of this volume for the shortfall, if any, from the declared guaranteed " Net Genset Heat Rate at 100% of the module base load.
- d). Net Genset heat rate at 100% of Genset base load beyond (+) 2 % of the Guaranteed Net Genset Heat Rate at 100% of the module base load. : At it's discretion may either accept the equipment/ system after levying Liquidated Damages for the shortfall from the quoted Guaranteed "Net Genset heat rate at 100% of Genset base load, as per Clause No.3.00.00 of this Volume or reject the equipment/ system and recover the payment already made.

1.02.04 Availability Guarantee of Plant

- (a). The bidder shall guarantee 'Availability' of Plant'. The availability guarantee for the Plant shall start after successful completion of Performance & Guarantee Tests at Site

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GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

and from the start of O&M contract. The Contractor shall ensure min. 90% availability of Plant on yearly basis for a period of 03 (Three) years of O&M contract period. For the purpose of establishing compliance to this clause, the contractor shall incorporate necessary features/ software in the Distributed Digital Control, Monitoring and Information System (DDCMIS) and extraneous factors leading to module trip should be suitably interlocked and this information should be logged in DDCMIS.

- (b). 'Availability' plant shall be calculated as follows:

$$\text{Availability (A) in \%} = 100 \times (P - S - F) / P$$

Where,

P = Total Net Power generation in a year considering continuous operation of the all genset at full load capacity throughout the year.

S = Generation loss due to scheduled outages for all planned maintenance/ inspections of the plant.

F = Generation loss due to forced/ unplanned outages of plant solely attributable to the contractor.

If during the availability guarantee period, the Plant availability in terms of net generation (sum of net actual generation and deemed generation) falls below 90% of Net generation corresponding to the demonstrated Net capacity during PG test, then the liquidated damages shall be levied as specified in clause 3.00.00 of Volume-V, Part-A, of Technical Specifications.

Employer shall accept the Plant availability only upto 85% with levying Liquidated Damages as per Clause No. 3.00.00 of this Volume. In case the availability falls below 85% in a year, then Employer at it's discretion may either accept the equipment/ system after levying Liquidated Damages for the shortfall from the quoted Guaranteed availability, as per Clause No. 3.00.00 of this Volume or reject the equipment/ system and recover the payment already made.

- (c). If at the end of O&M contract period i.e. during 3rd year, in case contractor is not able to demonstrate minimum plant availability of 90%, then Lumpsum LD for deficiency in plant availability in addition to LD for 3rd year shall be paid by the contractor as mentioned in Clause. No. 3.00.00.

1.03.00 STATUTORY GUARANTEES

1.03.01 The Contractor shall establish following Statutory (Category II) Guarantees:

- (i). a. NOx emission level of less than 80 ppm (dry volume basis corresponding to 15% excess oxygen in Engine exhaust) while operating at 100%, 90%,80%,70%,60% & 50% of Base Load Output.
- (ii). Noise level (near field and far field) of Engines, Generators/Alternators and including all the auxiliaries and their system at 100% and 80% of the base load of Gensets as per the applicable Norms.

1.03.02 No tolerance or allowance on the test results will be permitted for the instrument error & inaccuracy, human error, the method of testing or for any other cause. If the contractor is

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GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

not able to demonstrate the specified Guarantees, even after the modifications / replacements within ninety (90) days of the notification by the Owner/Client, the Owner/Client will reject the equipment/ system and recover the payment already made.

1.04.00 DEMONSTRATION GUARANTEES

1.04.01 'Demonstration Guarantees' or 'Category III Guarantees' are required to be demonstrated during 'Initial Operation' or 'Guarantee Test' of the respective Genset Unit, Equipment or System, as the case may be. No tolerance or allowance on the test results will be permitted for Instrument error or inaccuracy, human error, the method of testing or any other cause.

1.04.02 If it is found that a Demonstration Guarantee is not met, the Contractor shall carry out all necessary modifications and or/ replacements to make the equipment/ system comply with the guaranteed requirements at no extra cost to the Owner/Client and reconduct the Guarantee Test(s) with Owner's/Client's consent. If the Contractor is not able to demonstrate the Guarantees, even after the modifications / replacements within ninety (90) days of the notification by the Employer, the Employer will:

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

OR

b. Accept the equipment/ system/ plant after assessing the various parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Owner/Client. This amount shall be limited to the cost of replacement of equipment/system, replacement of which shall remove the deficiency so as to achieve the guarantee performance-

1.04.03 Following Category III Guarantees shall be demonstrated:

Plant Auxiliaries

(a) Effluent Treatment Plant for Waste Water: Capacity, chemical consumption and guaranteed effluent quality parameters as specified in Chapter-M3 of Volume-I, Part-B, Section-VI.

(b) Quantity of Overall Plant makeup water and Overall Plant Effluent Discharge.

(c) Package Air Conditioning (PAC) Unit

(i) Specified temperature and humidity of conditioned space under worst ambient conditions.

(ii) Demonstration of rated capacity of PAC unit.

(d) Fire Detection and Protection System

(i) Following shall be demonstrated at Shop
Capacity, Head & Power consumption of fire water pumps.

(e) Compressed Air System

A Following shall be demonstrated at shop:

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GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

i) Capacity and discharge pressure of each air compressor.

B Following shall be demonstrated at site:

i) Parallel operation of air compressors

ii) Dew point of air at the outlet of air drying plants of instrument air compressor.

iii) Pressure drop across the air drying plants of air compressors.

iv) Vibration level of air compressors, blowers of air drying plant.

2.00.00 CONDUCTANCE OF PERFORMANCE / ACCEPTANCE TESTS

2.01.00 General

2.01.01 The responsibility of conducting the Performance Guarantee Test and establishing all the Guarantees and the Demonstration parameters / capabilities to the satisfaction of Employer, lies with the Contractor.

2.01.02 Functional Guarantees/Demonstration shall be conducted at Site by the Contractor in presence of the Employer/Client. The contractor's Commissioning and start-up Engineer shall make the unit ready to conduct such test before start of initial operation. Such test shall be conducted along with the Initial Operations.

2.01.03 Performance Guarantee/ Acceptance Tests shall be carried out in accordance with specified Performance Test Codes and the requirements stipulated in Technical Specifications.

2.01.04 All special equipment, instruments, tools & tackles and other services required for the successful completion of the performance and guarantee tests as well as the demonstration tests shall be provided by the Contractor.

2.01.05 Owner/Client shall attend the Factory Acceptance Tests of all the Engines and ~~along with~~ Alternators.

2.02.00 Test Plan

2.02.01 The Contractor shall prepare a Test Plan for the specified Acceptance Tests. It shall include following:

- a. Schedule of Activities for Preparation of Test, Pretest, Main Test, Evaluation and Preparation of Test Results.
- b. Responsibilities of Parties involved.
- c. Agreed and approved Test Procedure (duly signed by the authorized signatories of all the involved parties).
- d. Details of Test Apparatus and Instrumentation including calibration reports.
- e. Details of the Test Laboratories

2.02.02 The Contractor shall submit a consolidated Test Plan Document comprising the above to the Employer prior to start of Preparation for Performance Guarantee Test.

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GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

2.03.00 Test Procedure

2.03.01 The Bidder shall necessarily include in his proposal proposed Performance Guarantee Test Procedure and Sample Calculation for evaluation of Performance Guarantees (Genset Net Power Output, Genset Net Heat Rate, Availability, Statutory Guarantees and Demonstration Guarantees). The successful bidder procedure submitted with the offer shall be discussed and agreed with the Employer. A detailed final PG Test Procedure in accordance with the applicable test codes, specification requirements and agreements reached prior to award of the Contract shall be prepared during detailed engineering. Detailed Test Procedure shall be finalized prior to the commencement of commissioning activities.

2.03.02 Test Procedure Document shall necessarily include all the details indicated below in the same sequence of appearance:

- a. Index
- b. Objective of Test
- c. Base Reference Conditions for the Guaranteed Performance
- d. Guaranteed Performance, Statutory and Demonstration Guarantees
- e. Applicable Performance Test Codes clearly indicating their applicability
- f. Defined Test Boundaries
- g. Applicable heat balance diagrams (HBDs) and Correction curves
- h. PG Test Instrumentation Scheme
- i. Calibration requirements for all instrumentation to be used in Performance Guarantee test
- j. Measurement – frequency and method of recording the test readings
- k. Sample collection, handling and analysis method
- l. Method of Plant Operation during Performance Guarantee Test
- m. Preparation for Test – Equipment Inspection, Cleaning, Making the equipment ready for test (installation of temporary test instrumentation etc.).
- n. Allowable variation in test conditions with respect to Design Reference Conditions
- o. Number of Test Runs, Duration of each Run, Number of Readings etc.
- p. Test Start and Stop requirements
- q. Data Acceptance and Rejection Criteria
- r. Sample Calculation
- s. Properties of Air, Flue Gas, Water, and Constituent Properties of RLNG to be used in evaluation of Test Results
- t. Format of Test Report

GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

2.04.00 Performance Test Codes

2.04.01 Performance Guarantee/ Acceptance tests shall be conducted in accordance with the latest editions of relevant codes and standards for respective equipment/systems.

2.05.00 Measuring Equipment

2.05.01 For all measurements the Contractor shall provide the necessary instrumentation and test equipment. All the instruments will be calibrated by the Contractor before the tests in a reputed International Institute as approved by the Employer.

2.05.02 The calibration certificates shall be submitted to the Employer fifteen days prior to the tests. Batch calibration is not acceptable. The calibration shall be valid for the period mentioned in the certificate. At the time of acceptance test, calibration of instruments should be valid as per calibration certificate.

2.05.03 All costs associated with the supply, calibration, installation of test instruments and equipment shall be included in the bidder's scope.

2.08.00 NOx Measurement and Evaluation

2.08.01 Sampling, measurement and calculation method for NOx level in Engine exhaust shall be in accordance with US EPA Method 20. NOx measurement shall be established procedures such as the Non Dispersion Ultra Violet / Non Dispersive Infra Red Chemiluminescence type analyser. During measurement of NOx, oxygen content in the flue gas shall also be measured and the measured NOx value shall be corrected for 15 % excess oxygen in flue gas. Measured NOx value shall be corrected first for Dry Volume basis and the value thus obtained shall be corrected for 15% excess oxygen in the flue gas as follows:

2.08.02 Detailed Method of NOx measurement, calculation method, sample calculation and evaluation of result shall be included in Test Procedure Document.

2.09.00 Test Reports

2.09.01 The Contractor shall prepare a Test Report, and submit to the Employer within a time period agreed in Test Plan.

2.09.02 The Test Report shall include following information:

- a. Performance Guarantees and Design Reference Conditions
- b. Description of Test Conducted
- c. Calculation for Test Condition and Correction for Design Reference Conditions
- d. Records of Readings taken during the Test
- e. Calculation for Test Condition and Correction for Design Reference Conditions
- f. Comparative Table of Corrected Test Results and Guarantee Performance Values
- g. Post Test uncertainty analysis
- h. Discussion on the Test and its Results
- i. Conclusion

GUARANTEES, PERFORMANCE TESTING & LIQUIDATED DAMAGES

3.00.00 LIQUIDATED DAMAGES FOR SHORTFALL IN GUARANTEED PERFORMANCE

3.01.00 The Liquidated Damages (LD) for shortfall in guaranteed performance, if any, shall be levied as indicated below:

S.No.	Description	Value
1.	Net Heat Rate at 100% of Engine load.	₹405150/ (INR/kCal/kwh/MW) x Δ HRg x Y/1000
2.	Net Output of Genset INR/kW	₹ 139677 /(KW)x Δ Y
3.	Deficiency in Plant Availability per 0.1% shortfall in availability (to be levied at the end of every year for 03 years)	₹ 4643/ (MW) x net Plant output in MW
4.	Deficiency in Plant Availability per 0.1% shortfall in availability (Lumpsum to be levied at the end of 03 years)	₹ 35493/(MW) x net Plant output in MW

Where:

Δ HRg	Increase in Net Heat Rate at 100% of Net output of Engine from guaranteed value in Kcal/Kwh.
Y	Guaranteed Net Power output of each Engine quoted by bidder in KW at 100% load. The net Output shall be restricted by the upper limit of the range prescribed for the plant.
Δ Y	Decrease in Net Power Output of each Engine from guaranteed value in KW.

Note :

(i) Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Total Contract Price. i.e. sum of all the three contract price. The functional guarantees shall include net heat rate of the engine, net output of genset and availability of plant.

(ii) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

GENERAL TECHNICAL REQUIREMENTS

PART-A

VOLUME – VI

GENERAL TECHNICAL REQUIREMENTS (GTR)

GENERAL TECHNICAL REQUIREMENTS

1.00.00 INTRODUCTION

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 BRAND NAME

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 BASE OFFER & ALTERNATE PROPOSALS

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 COMPLETENESS OF FACILITIES

4.01.00 Bidders may note that this is an EPC Package contract. Plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 CODES & STANDARDS

GENERAL TECHNICAL REQUIREMENTS

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

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

GENERAL TECHNICAL REQUIREMENTS

(v.) Any other statutory codes / standards / regulations, as may be applicable.

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

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

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

GENERAL TECHNICAL REQUIREMENTS

- 5.04.00 Deleted
- 5.05.00 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
- 5.06.00 Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two (2) weeks from the date of the Notification of Award.
- 5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
- 5.08.00 A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform is indicated in this volume and elsewhere in the specification.
- 6.00.00 **EQUIPMENT FUNCTIONAL GUARANTEE**
- 6.01.00 The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.
- 6.02.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.
- 7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**
- 7.01.00 **DESIGN OF FACILITIES**
- All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.
- The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.
- 7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

GENERAL TECHNICAL REQUIREMENTS

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

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspections of the Engine, Generator/Alternator, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

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

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR

8.01.00 Bidders may note that this is an **EPC Package contract**. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works as per the scope.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engineering and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this volume of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) BASIC ENGINEERING DOCUMENTATION

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within three (3) weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

- i) Description of all the mechanical, electrical, control & instrumentation & civil systems.

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- ii) Technology scan for each system / sub-system & equipment.
- iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.
- iv) Optimisation studies including thermal cycle optimisation.
- v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.
- vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- vii) Water Balance diagram, if applicable.
- viii) Operation Philosophy and the control philosophy of the Main Plant and Balance of Plant (BOP).
- ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs.
- x) Basic layouts and cross sections of the Engine Hall & Utility Building, fuel oil area, transformer yard/switchyard and other areas included in the scope of the bidder.
- xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within two (2) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) DETAILED ENGINEERING DOCUMENTS

- i) General layout plan of the plant.
- ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
- iii) Flow diagram, process and instrumentation diagrams along with write up and system description.
- iv) Start up curves for Engine-Generator/Alternator set.

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- v) Piping isometric, composite layout and fabrication drawings.
- vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.
- vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.
- viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like pumps, Air compressors etc.
- ix) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.
- x) Thermal cycle information (heat balance diagrams and heat exchanger thermal calculations etc.).
- xi) Comprehensive list of all terminal points which interface with Employer's/Client's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details etc.
- xii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- xiii) Protection system diagrams and relay settings.
- xiv) Cables schedules and interconnection diagrams.
- xv) Cable routing plan.
- xvi) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
- xvii) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.
- xviii) Sequence and protection interlock schemes.
- xix) Type test reports, insulation co-ordination study report and power system stability study report.

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- xx) Control system configuration diagrams and card circuit diagrams and maintenance details.
- xxi) Detailed DDCMIS system manuals.
- xxii) Detailed flow chart for digital control system.
- xxiii) Mimic diagram layout, Assignment for other application engineering.
- xxiv) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.
- xxv) Underground facilities, levelling, sanitary, landscaping drawings.
- xxvi) Geotechnical investigation and site survey reports (if and as applicable).
- xxvii) Model study reports wherever applicable.
- xxviii) Functional & guarantee test procedures and test reports.
- xxix) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

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

8.03.02 INSTRUCTION MANUALS

The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipment covered under the Contract within nine (9) months from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-VI**. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

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

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- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipments like cranes, dozers, etc.
- f) Bill of Materials
- g) Procedure for erection and General Safety procedures to followed during erection/installation.
- h) Procedure for initial checking after erection.
- i) Procedure for testing and acceptance norms.
- j) Procedure / Check list for pre-commissioning activities.
- k) Procedure / Check list for commissioning of the system.
- l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

- a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.
- b) The arrangement and contents of O & M manuals shall be as follows:
 - i) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied
- (a) Description of operating principle of equipment / system with schematic drawing / layouts.

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- (b) Functional description of associated accessories / controls. Control interlock protection write up.
- (c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).
- (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.
- (e) Design data against which the plant performance will be compared.
- (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.
- (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).
- (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

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

- (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.
- (b) Limiting values of all protection settings.
- (c) Various settings of annunciation/interlocks provided.
- (d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.
- (e) Do's and Don'ts related to operation of the equipment.
- (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.
- (g) Parameters to be monitored with normal value and limiting values.
- (h) Equipment isolating procedures.
- (i) Trouble shooting with causes and remedial measures.

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- (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.
 - (k) Routine Operational Checks, Recommended Logs and Records
 - (l) Change over schedule if more than one auxiliary for the same purpose is given.
 - (m) Preservation procedure on long shut down.
 - (n) System/plant commissioning procedure.
- 3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.
- (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.
 - (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.
 - (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.
 - (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.
 - (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.
 - (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.
 - (g) Long term maintenance schedules
 - (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.
 - (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.
 - (j) Tolerance for fitment of various components.

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- (k) Details of sub vendors with their part no. in case of bought out items.
- (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NVVN.
- (m) List of mandatory and recommended spares along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.
- (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.
- (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 PLANT HANDBOOK AND PROJECT COMPLETION REPORT

8.03.03.01 PLANT HANDBOOK

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

- i) Design and performance data.
- ii) Process & Instrumentation diagrams.
- iii) Single line diagrams.
- iv) Sequence & Protection Interlock Schemes.
- v) Alarm and trip values.
- vi) Performance Curves.
- vii) General layout plan and layout of Engine Hall & Utility Building.

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

The plant handbook shall be submitted within ten (10) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 PROJECT COMPLETION REPORT

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

8.03.04 DRAWINGS

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

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

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

- ii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI**.
- b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.
- c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.
- d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION".

Further, space shall be identified on each drawing for Approval stamp and electronic signature.

- f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.
- g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.
- h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer/Client indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.
- i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

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

j) As Built Drawings

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

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

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

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

8.03.05 e-Learning Package:

e-learning packages shall be supplied for the equipment / system for the following Engine-Generator/Alternator set & auxiliaries along with associated electrical and C&I system.

8.03.05.01 These packages shall be installed on the Learning Management Server (LMS) of NVVN/Power Management Institute (PMI), NTPC located at Noida. The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified above is

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to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system.

2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above.
 - a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.
 - b. The commissioning course(s) should include instructions on pre-commissioning, commissioning, initial operation etc.
 - c. The operation course(s) should include instructions on the permissive, interlocks, physical check ups, start up , shutdown and protections etc.
 - d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

Depth of coverage of above courses shall be as specified for “**Instruction Manuals**” in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or representative before acceptance by NVVN. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site. The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.
4. **e-Learning course broad requirements:**
 - a. The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.
 - b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.
 - c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.
 - d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.
 - e. Each course shall have every physical and functional detail of the equipment / system supplied.
 - f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.

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- g. There shall be option for self-assessment test after every course. In case the user doesn't opt for self assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.
- h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.
- i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.
- j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.
- k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.
- l. The system shall provide the user with the ability to select the information with a Cursor.
- m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.
- n. Every course shall contain the 3D design/drawing/exploded view/360° turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio.
- o. The users shall be able to control audio sound level associated with the courses.
- p. Drawings / text in the courses shall be scalable (Zoom In/ Out).
- q. The user shall have the capability to record a **bookmark** to mark displayed information for later recall, whenever he accesses the same course next time.

Notes:

- 1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
- 2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.
- 3. The vendor shall get the approval of one sample course from EIC before proceeding for further courses.

8.04.00 Not used

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8.05.00 Engineering Co-ordination Procedure

8.05.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

NVVN Engineering Coordinator (NVVN EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.05.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.05.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NVVN's information/ interface and or review and approval are referred by the general term "drawings".

b) Not used

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall

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furnish this format to his subvendor along with his purchase order for subvendor's compliance.

- d) Not used
- e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.
- f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.
- g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NVVN and their comments shall be forwarded within three (3) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- I Approved

CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.

CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.

CATEGORY -IVFor information and records.

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

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portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.

- i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NVVN for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.
- l) These comments will be taken care by the contractor while submitting the revised drawing.

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

8.06.00 ENGINEERING PROGRESS AND EXCEPTION REPORT

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

- a) A list of drawings/engineering information which remains unapproved for more than three (3) weeks after the date of first submission
- b) Drawings which were not submitted as per agreed schedule.

8.06.02 The draft format for this report shall be furnished to the Employer within two (2) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

9.00.00 TECHNICAL CO-ORDINATION MEETING

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

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- 9.02.00 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.
- 9.02.01 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
- 9.02.02 Should any drawing remain unapproved for more than four (4) weeks after its first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.
- 9.03.00 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

10.00.00 DESIGN IMPROVEMENTS

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

11.00.00 EQUIPMENT BASES

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

12.00.00 PROTECTIVE GUARDS

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Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00 LUBRICANTS, SERVO FLUIDS AND CHEMICALS

13.01.00 All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

13.02.00 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.

14.00.00 LUBRICATION

14.01.00 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

15.00.00 MATERIAL OF CONSTRUCTION

15.01.00 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.

16.00.00 RATING PLATES, NAME PLATES & LABELS

16.01.00 Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

16.02.00 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

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- 16.03.00 Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
- 16.04.00 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
- 16.05.00 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.
- 16.06.00 Valves and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire.
- 16.07.00 Safety and relief valves shall be provided with the following:
- a) Manufacturer's identification.
 - b) Nominal inlet and outlet sizes in mm.
 - c) Set pressure in Kg/cm² (abs).
 - d) Blowdown and accumulation as percentage of set pressure.
 - e) Certified capacity in kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
- 16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning

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and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES

All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

19.00.00 PROTECTION AND PRESERVATIVE SHOP COATING

19.01.00 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

19.02.00 PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

19.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

19.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

19.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

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19.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications or as per standard approved practices for the location and climate condition of the plant.

20.00.00 QUALITY ASSURANCE PROGRAMME

20.01.00 The Contractor shall adopt suitable quality assurance programme to ensure that equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer or authorised representative after discussions before the award of the contract. Quality assurance programme shall generally cover the following:

- a. Organisation structure for the management and implementation of the proposed quality assurance programme
- b. Quality System Manual
- c. Design Control System
- d. Documentation Control System
- e. Qualification data for Bidder's key Personnel.
- f. Procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- g. System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- h. Control of non-conforming items and system for corrective actions and resolution of deviations.
- i. Inspection and test procedure both for manufacture and field activities.
- j. Control of calibration and testing of measuring testing equipments.
- k. System for Quality Audits.
- l. System for indication and appraisal of inspection status.
- m. System for authorizing release of manufactured product to the Employer.
- n. System for handling storage and delivery.
- o. System for maintenance of records, and
- p. Furnishing of Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment / component as per formats enclosed as Annex-I & Annex-II respectively.

21.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

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- 21.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.
- 21.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, web based system of NVVN ERP for review and approval.
- 21.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities from receipt of materials/equipment at site.
- 21.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans. These documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/ Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and disposition.
- 21.05.00 The contractor shall submit to the Employer Field Welding Schedule for field welding activities. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
- 21.06.00 The contractor shall have suitable Field Quality Organisation with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organisational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities
- 21.07.00 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).

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- 21.08.00 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details/procedures.
- 21.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.
- 21.10.00 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 21.11.00 Welding procedure qualification and Welder Qualification test results shall be furnished to the Employer for reference. However, where required by the Employer, tests shall be conducted in presence of Employer/ authorised representative.
- 21.12.00 For all pressure parts and high pressure piping welding, any statutory requirements for the equipments/systems shall be complied with.
- 21.13.00 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 21.14.00 No welding shall be carried out on cast iron components for repair.
- 21.15.00 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 21.16.00 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/ evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.
- All bar stock / forging of diameter equal to or greater than 50 mm shall be ultrasonically tested. In general all plates equal to or greater than 40mm and for pressure parts, plate of thickness equal to or greater than 25mm shall be ultrasonically tested unless otherwise as specified in respective specification.
- 21.17.00 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along

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with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

- 21.17.00 a An indicative list of sub-vendors accepted by NTPC/NVVN in the past for Corporate Awarded similar packages is enclosed for reference purpose.
- 21.18.00 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor..
- 21.19.00 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their subvendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 22.20.00 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. He shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 21.21.00 Quality audit, surveillance, approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 21.22.00 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 21.23.00 Repair/ rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
- 21.24.00 **Environmental Stress Screening**
Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV

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components, PA systems etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract. For other approved sub vendors of above mentioned systems, contractor shall furnish the test procedure for eliminating infant mortile components in case, if it is asked for by the employer before these items are offered for inspection / dispatched to site.

21.25.00 Software Reliability/ Quality Certification

Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β -version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC/NVVN as a part of quality documentation review and approval process during detail engineering.

22.00.00 QUALITY ASSURANCE DOCUMENTATION PACKAGE

22.01.00 The Contractor shall be required to submit the QA documentation in soft form as identified in respective quality plan with tick (✓) mark.

22.02.00 Each QA documentation shall have a project specific cover sheet bearing name and identification number of equipment and including an index of its contents with page control on each document.

22.03.00 The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing

22.04.00 The final Quality document will be compiled and issued at the final assembly place of equipment before dispatch.

22.05.00 Typical content of QA documentation shall be as follows:

- a. Quality Plans
- b. Material mill test reports on components as specified by the specification and approved Quality Plans.
- c. Manufacturer / works test reports and results for testing required as per applicable codes and standard referred in the specification and approved quality plans.
- d. Nondestructive examination results including radiography interpretation reports.
- e. Heat Treatment Certificates or Records (Time – Temperature Chart)
- f. All the accepted Non-conformance Reports (major or minor), Deviations including complete technical details, repair procedure etc.
- g. Customer Hold Points (CHP)/ Inspection reports duly signed by QA personnel of the Employer and Contractor for the agreed Customer Hold Points.
- h. Certificate of Conformance (COC), wherever required.
- i. MDCC

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- 22.06.00 Similarly, the contractor shall be required to submit two sets (CD), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.
- 22.07.00 Before dispatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.
- 22.07.01 If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- 22.07.02 If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness in order to finalize the quality document (or applicable section) within a period compatible with the requirements of contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- 22.07.03 If a decision is made to dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 03 weeks after the dispatch of equipment.
- 22.08.00 Transmission of QA Documentation
- 22.08.01 On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.
- 22.08.02 For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.
- 23.00.00 PROJECT MANAGER'S SUPERVISION**
- 23.01.00** To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager of Employer and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.
- 23.02.00** The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract will include but not be limited to the following:
- Interpretation of all the terms and conditions of these documents and specifications;
 - Review and interpretation of all the Contractor's drawing, engineering data, etc;
 - Witness or authorize his representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract;
 - Inspect, accept or reject any equipment, material and work under the contract;

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- e. Issue certificate of acceptance and/or progressive payment and final payment certificates;
- f. Review and suggest modifications and improvement in completion schedules from time to time, and
- g. Supervise Quality Assurance Programme implementation at all stages of the works.

24.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

- 25.01.00 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 24.02.00 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 24.03.00 The Contractor shall give the Project Manager/Inspector ten (10) working days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within ten (10) working days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports.
- 24.04.00 The Project Manager or Inspector shall within ten (10) working days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 24.05.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

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- 24.06.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
- 24.07.00 The inspection by Project Manager and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 24.08.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 23.03.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 24.09.00 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NVVN. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

25.00.00 ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME

	Document	Format No.
i.	Manufacturing Quality Plan	QS-01-QAI-P-09/F1-R0 (Annexure – I)
ii.	Field Quality Plan	QS-01-QAI-P-09/F2-R0 (Annexure – II)

26.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

- 26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Section-VI and elsewhere in the Technical Specifications.

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- (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.
- (c) All piping system shall be flushed, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.
- (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- (e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer.
- (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.02.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eight (8) months prior to the schedule date of synchronization of 1st Genset. The chart should contain:

- (1.) Biodata including experience of the Commissioning Engineers.
- (2.) Role and responsibilities of the Commissioning Organisation members.
- (3.) Expected duration of posting of the above Commissioning Engineers at site.

26.03.00 Initial Operation

- (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

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- (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 7 days continuously. During the period of initial operation of 7 days, the unit shall operate continuously at full rated load for a period not less than 72 hours.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

- (c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.
- (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.04.00

GUARANTEE TESTS

- a) The final tests as specified in Volume-V, Part-A and Part-B to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer/Client. The contractor's commissioning and start-up **Engineer** shall make the unit ready to conduct such test **before start of initial operation**. Such test **shall be conducted along with the** Initial Operations.
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.
- c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.
- d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

GENERAL TECHNICAL REQUIREMENTS

- e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specifications.
- f) All the defects including those pointed out by the owner/client during the initial trial operation period and while conducting Performance Guarantee tests, shall be rectified by the contractor by the end of the initial trial operation period.

27.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 TRAINING OF EMPLOYER'S PERSONNEL

28.01.00 The scope of service under training of Employer's personnel shall include a training module covering the areas of Engineering, Operation & Maintenance.

28.03.00 The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.

28.04.00 Total duration of the training shall be of 5 (five) man months. The break-up of the training period shall be as following-

- i. 1 (One) Man month – At Engine manufacturers works/factory
- ii. 4 (four) Man months - Comprehensive training program consisting of classroom and plant visit of similar running plant for Employer's personnel for safe and efficient operation of the plant addressing the erection, commissioning, operation and maintenance aspects of the plant.

Accommodation with lodging and boarding and local conveyance at the place of training shall be provided to the Employer's personnel free of cost. Cost of journey to and from the place of training shall be borne by the Employer.

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Details of the training shall be finalized during detail engineering of the project.

Note :

1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.
2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage.

29.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- i) Working platforms should be fenced and shall have means of access.
- ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.00.00 NOISE LEVEL

The noise levels shall meet the MoEF&CC guidelines as enclosed at Annexure-IA of Volume IV, Part-A, Section-VI and requirements specified elsewhere.

31.00.00 PACKAGING AND TRANSPORTATION

31.01.00 All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection.

31.02.00 Bidder shall carry out detail study regarding the transport facilities available at the project location including port handling facilities for safe transportation of various equipment and system to the project site.

31.03.00 Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

31.04.00 The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

32.00.00 ELECTRICAL EQUIPMENTS/ENCLOSURES

32.01.00 All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

GENERAL TECHNICAL REQUIREMENTS

33.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

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

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

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

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

34.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro

GENERAL TECHNICAL REQUIREMENTS

Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

35.00.00 SURGE PROTECTION FOR SOLID STATE EQUIPMENT

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates etc. shall be submitted by the Bidder.

36.00.00 INSTRUMENT AIR SYSTEM

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

- i) Temperature test pockets with stub and thermowell
- ii) Pressure test pockets

38.00.00 SYSTEM DOCUMENTATION

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site.

GENERAL TECHNICAL REQUIREMENTS

The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

39.00.00 MAINTENANCE MANUALS OF ELECTRONIC MODULES

The Contractor shall have to furnish two (2 nos.) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.

GENERAL TECHNICAL REQUIREMENTS

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1
IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)

GENERAL TECHNICAL REQUIREMENTS

IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform- ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957
IS:3346	Method for the determin- ation of thermal conductivity of thermal insulation materials (two slab guarded	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and

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	hot plate method)	materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocry-stallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	
IS:4540	Specification for monory-stallines rectifire assembly equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	

GENERAL TECHNICAL REQUIREMENTS

IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
IS:7938	Air receivers for compressed air installation	
ISO:1217	Displacement compressor-Acceptance test	
ASHRAE-33 heating coils.	Methods of testing for rating of forced circulation air cooling and air	
ASHRAE-52-76 matter.	Air cleaning device used in general ventilation for removing particle	
ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.	
ASHRAE 23-67 compressors.	Methods of testing for rating of positive displacement refrigerant	
ARI-450-6	Standard for water cooled refrigerant condensers.	

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

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

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

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

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IS: 4701	Code of practice for earth work on canals.
IS: 9758	Guide lines for Dewatering during construction.
IS: 10379	Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269	Specification for ordinary Portland cement, 33 grade.
IS: 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS: 432	Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.
IS: 455	Specification for Portland slag cement.
IS: 702	Specification for Industrial bitumen.
IS: 712	Specification for building limes.
IS: 808	Rolled steel Beam channel and angle sections.
IS: 1077	Specification for common burnt clay building bricks.
IS: 1161	Specification of steel tubes for structural purposes.
IS: 1363	Hexagon head Bolts, Screws and nuts of production grade C.
IS: 1364	Hexagon head Bolts, Screws and Nuts of Production grade A & B.
IS: 1367	Technical supply conditions for Threaded fasteners.
IS: 1489	Specification for Portland-pozzolana cement:
(Part-I)	Fly ash based.
(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.

GENERAL TECHNICAL REQUIREMENTS

IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.
IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS: 8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

Cast-In-Situ Concrete and Allied Works

IS: 280	Specification for mild steel wire for general engineering purposes.
IS: 456	Code of practice for plain and reinforced concrete.
IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
IS: 516	Method of test for strength of concrete.
IS: 650	Specification for standard sand for testing of cement.
IS: 1199	Methods of sampling and analysis of concrete.
IS: 1791	General requirements for batch type concrete mixers.
IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).

GENERAL TECHNICAL REQUIREMENTS

IS: 2204	Code of practice for construction of reinforced concrete shell roof.
IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS: 2438	Specification for roller pan mixer.
IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS: 2505	General requirements for concrete vibrators, immersion type.
IS: 2506	General requirements for concrete vibrators, screed board type.
IS: 2514	Specification for concrete vibrating tables.
IS: 2645	Specification for Integral cement water proofing compounds.
IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
IS: 2750	Specification for Steel scaffolding.
IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS: 3025	Methods of sampling and test waste water.
IS: 3366	Specification for Pan vibrators.
IS: 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558 concrete.	Code of practice for use of immersion vibrators for consolidating
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326	Code of practice for earthquake resistant design and construction of buildings.

GENERAL TECHNICAL REQUIREMENTS

IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.
IS: 4990	Specification for plywood for concrete shuttering work.
IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.
IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.
IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.

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IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.
Part-2	Rebound hammer.
SP:23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/	National Building Code- Structural design of prefabrication and systems building. Sec.7)
IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonry and Allied Works

IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.
IS: 2212	Code of Practice for Brickwork.
IS: 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP: 20	Explanatory hand book on masonry code.

Sheeting Works

IS:277	Galvanised steel sheets (plain or corrugated).
IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.
IS: 513	Cold-rolled carbon steel sheets.
IS: 730	Specification for fixing accessories for corrugated sheet roofing.
IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.

GENERAL TECHNICAL REQUIREMENTS

IS: 3007	Code of practice for laying of asbestos cement sheets.
IS: 5913	Methods of test for asbestos cement products.
IS: 7178	Technical supply conditions for tapping screw.
IS: 8183	Bonded mineral wool.
IS: 8869	Washers for corrugated sheet roofing.
IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS: 12866	Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.

Fabrication and Erection of Structural Steel Work

IS: 2016	Specification for plain washers.
IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.
IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.

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IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Hand book for structural Engineers.
IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

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Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.
IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
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GENERAL TECHNICAL REQUIREMENTS

IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copper alloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.
IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.
IS : 1742	Code of practice for building drainage.
IS : 1795	Pillar taps for water supply purposes.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.

GENERAL TECHNICAL REQUIREMENTS

IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water-closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non-ferrous waste fittings for wash basins and sinks.
IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone-ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.

GENERAL TECHNICAL REQUIREMENTS

IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.
IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP: 35	Hand book on water supply and drainage.
-Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.	

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.

GENERAL TECHNICAL REQUIREMENTS

IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.
IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels
IS:2209	Mortice locks (vertical type).
IS:2553	Safety glass
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated).
IS : 3614	Fire check doors; plate, metal covered and rolling type.
IS:4351	Steel door frames.
IS:5187	Flush bolts.
IS:5437	Wired and figured glass
IS:6248	Metal rolling shutters and rolling grills.
IS:6315	Floor springs (hydraulically regulated) for heavy doors.
IS:7196	Hold fasts.
IS:7452	Hot rolled steel sections for doors, windows and ventilators.
IS:10019	Mild steel stays and fasteners.
IS:10451	Steel sliding shutters (top hung type).
IS:10521	Collapsible gates.

Roof Water Proofing and Allied Works

IS:1203	Methods of testing tar and bitumen.
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GENERAL TECHNICAL REQUIREMENTS

IS:1322	Specification for bitumen felts for water proofing and damp proofing.
IS:1346	Code of practice for water proofing of roofs with bitumen felts.
IS:1580	Specification for bituminous compound for water proofing and caulking purposes.
IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.

Floor Finishes and Allied Works

IS:1237	Specification for cement concrete flooring tiles.
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2114	Code of practice for laying in-situ terrazzo floor finish.
IS:2571	Code of practice for laying in-situ cement concrete flooring.
IS:3462	Specification for unbacked flexible PVC flooring.
IS:4971	Recommendations for selection of industrial floor finishes.
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.

Painting and Allied Works

IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.

GENERAL TECHNICAL REQUIREMENTS

IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship
Part-II	Schedules
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part-I	Operations and workmanship.
Part-II	Schedule.
IS:2524	Code of practice for painting of nonferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
IS:2933	Specification enamel paint, under coating and finishing.
IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS:5410	Specification for cement paint
IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use
IS:6278	Code of practices for white washing and colour washing.
IS:10403	Glossary of terms relating to building finishes.

Piling and Foundation

IS:1080	Code of practice for design and construction of simple spread foundations.
IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.
IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
IS:2950	Code of practice for designs and construction of Raft (Part-I) foundation.
IS:2974	Code of practice for design and construction of machine

GENERAL TECHNICAL REQUIREMENTS

(Part-I TO V)	foundations.
IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.
IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.
Part-I	Shallow foundations.
Part-II	Deep foundations.
IS:12070	Code of practice for design and construction of shallow foundations on rocks.
DIN:4024	Flexible supporting structures for machines with rotating machines.
VDI:2056	Criteria for assessing mechanical vibrations of machines.
VDI:2060	Criteria for assessing rotating imbalances in machines.
Roads	
IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.
IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.
IRC:16	Specification for priming of base course with bituminous primers.
IRC:19	Standard specifications and code of practice for water bound macadam.
IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).
IRC:34	Recommendations for road construction in waterlogged areas.
IRC:36	Recommended practice for the construction of earth embankments for road works.
IRC:37	Guidelines for the Design of flexible pavements.
IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
IRC:73	Geometric design standards for rural (non-urban) highways.
IRC:86	Geometric Design standards for urban roads in plains.
IRC:SP:13	Guidelines for the design of small bridges & culverts.
IRC - Public-	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS:73	Specification for paving bitumen

GENERAL TECHNICAL REQUIREMENTS

Loadings

IS:875	Code of practice for design loads other than earthquake) for
(Pt. I to V)	buildings and structures.
IS:1893	Criteria for earthquake resistant design of structures.
IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.

Safety

IS:3696	Safety code for scaffolds and ladders.
(Part I & II)	
IS:3764	Safety code for excavation work.
IS:4081	Safety code for blasting and related drilling operations.
IS:4130	Safety code for demolition of buildings.
IS:5121	Safety code for piling and other deep foundations.
IS:5916	Safety code for construction involving use of hot bituminous materials.
IS:7205	Safety code for erection on structural steelwork.
IS:7293	Safety code for working with construction machinery.
IS:7969	Safety code for handling and storage of building materials
IS:11769	Guidelines for safe use of products containing asbestos.
-	Indian Explosives Act. 1940 as updated.

Architectural design of buildings

SP:7	National Building Code of India
SP:41	Hand book on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.

GENERAL TECHNICAL REQUIREMENTS

IS:10430	Criteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes.

Publication

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

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

Temperature Measurements

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

Pressure Measurements

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

Flow Measurements

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

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

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973); IS:9319.
2. Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974.

GENERAL TECHNICAL REQUIREMENTS

3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).
5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.
6. Printed circuit boards - IPC TM - 650, IEC 326 C.
7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).
11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).
12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.
13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.
14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.
15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.
16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.
17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.
18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.
19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.
20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.
21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.
22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

GENERAL TECHNICAL REQUIREMENTS

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.
2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).
2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).
3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.
2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.
3. Intrinsically safe apparatus - NFPA 493 1978.
4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.
5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTM A 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.
3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106
4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

GENERAL TECHNICAL REQUIREMENTS

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.
6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.
7. Printed Circuit Board - IPC TM 650, IEC 326C.
8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.
2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.
3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).
4. Codes for pressure piping - ANSI B 31.1
5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.
2. Seamless carbon steel pipe ASTM - A - 106.
3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.

GENERAL TECHNICAL REQUIREMENTS

4. Material for socket welded fittings - ASTM - A - 105.
5. Seamless ferritic alloy steep pipe - ASTM - A - 335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.
7. Composition bronze of ounce metal castings - ASTM - B - 62.
8. Seamless Copper tube, bright annealed - ASTM - B - 168.
9. Seamless copper tube - ASTM - B - 75.
10. Dimension of fittings - ANSI - B - 16.11.
11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.
2. Material of socketweld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI - B - 16.11.
4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)
8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.
9. Oxygen index and temperature index test - ASTM D - 2863.
10. Smoke density measurement test - ASTMD - 2843.
11. Acid gas generation test - IEC - 754 - 1.

GENERAL TECHNICAL REQUIREMENTS

12. Swedish Chimney test - SEN - 4241475 (F3).
13. Teflon (FEP) insulation & sheath test - ASTM D - 2116.
14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.
15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.
2. -do- Test Standards. NEMA VE-1-1979.
3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.

Public Address System

1. Specifications for loud speakers - IS:7741 (Part-I, II and III)
2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301
3. Specification for Public Address Amplifiers - IS:10426.
4. Code of practice for outdoor installation of PA system - IS:1982.
5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.
6. Basic environmental testing procedures for electronic and electrical items - IS:9000.
7. Characteristics and methods of measurements for sound system equipment - IS:9302
8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732
9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)
10. Fittings for rigid steel conduits for electrical wiring - IS:2667
11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994
2. BS : 4675 Part-2

ANNEXURE-I

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

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

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

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

1/1

ENGG. DIV./QA&I

ANNEXURE-II

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

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

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

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

1/1

ENGG. DIV./QA&I

ANDAMAN & NICOBAR GAS POWER PROJECT (50 MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-A	VOLUME – VI GENERAL TECHNICAL REQUIREMENT	PAGE 69 OF 71
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GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)

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

GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)

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

ERECTION CONDITIONS OF CONTRACT

PART-A

VOLUME – VII

ERECTION CONDITIONS OF CONTRACT

ANDAMAN & NICOBAR GAS POWER PROJECT (50 MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-A	VOLUME-VII ERECTION CONDITIONS OF CONTRACT	PAGE 1 OF 46
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ERECTION CONDITIONS OF CONTRACT

1.00.00 GENERAL

1.01.00 The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.

1.02.00 The Contractor upon signing of the Contract shall in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.

2.00.00 REGULATION OF LOCAL AUTHORITIES AND STATUTES

2.01.00 In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.

2.02.00 All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able 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 equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.

3.00.00 WELDING REQUIREMENTS (AS APPLICABLE)

The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:

3.01.00 Qualification of Weld Procedures

Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NVVN for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.

3.02.00 Welder's Qualification

Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.

All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorised to carry out welding.

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3.03.00 Records

Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.

3.04.00 MARKING

On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.

4.00.00 HEAT TREATMENT

4.01.00 Pre-heating, post-heating and post-weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local post weld stress relieving heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations.

The contractor & employer's representative, at start and at the end of HT Cycle shall sign the time and temperature charts for heat-treatment.

4.03.00 After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.

5.00.00 WELD EDGE PREPARATION

Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.

6.00.00 CLEANING AND SERVICING

6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.

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6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.

6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.

7.00.00 FIELD WELDING SCHEDULE

The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following:

- (a.) Drawing No (s)
- (b.) Location of the weld
- (c.) Size of the weld (outside diameter and thickness)
- (d.) Type of joints
- (e.) Material specifications
- (f.) Size of fillet on backing ring, when the type of joint is with backing ring
- (g.) Electrode/ filler metal specifications
- (h.) Number of welds per unit
- (i.) Quantity of filler metal per weld
- (j.) Indication of required Non-destructive Examination (NDE) for each weld
- (k.) Pre-heat temperatures for welding
- (l.) Process of welding
- (m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment".
- (n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.

8.00.00 SITE RUN MISCELLANEOUS PIPING

Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except

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where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.

9.00.00 THERMAL EXPANSIONS

All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.

10.00.00 PIPING SUPPORTS

10.01.00 Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.

10.02.00 The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.

11.00.00 PRESSURE TESTING

11.01.00 On completion of erection, Contractor is required to carry out hydraulic test to fulfill with the Statutory requirements. It is contractor responsibility to identify & fulfill all the statutory requirements.

11.02.00 All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated.

12.00.00 THERMOWELLS AND FLOW NOZZLES

12.01.00 All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.

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13.00.00 INSULATION, LAGGING AND CLADDING

The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder.

13.01.00 Piping, Pipe Fittings & Valves

All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.

13.01.01 Piping

The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.

13.01.02 Flanges

Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.

13.01.03 Bends and Elbows

Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.

13.01.04 Cladding

Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action/procedure to be implemented.

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13.01.05 Valves and Fittings

All valves and fittings (above valve size of 2 inches) installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.

13.02.00 Protection of Equipment during Insulation Applications

All equipment and structures shall be suitably protected from damage while applying insulation after completion of insulation. All equipment and structures shall be thoroughly cleaned and remove insulating materials which might have fallen on them.

14.00.00 CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules & Codes, ASME codes and accepted good practices, the Employer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.

15.00.00 ELECTRICAL SAFETY REGULATIONS

15.01.00 In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer.

15.02.00 Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall:

- (a) Satisfy the Employer that the appliance is in good working condition.
- (b) Inform the Employer of the maximum current rating, voltage and phase of the appliances.
- (c) Obtain permission of the Employer detailing the socket to which the appliances may be connected.

The Employer will not grant permission to connect until he is satisfied that

- (d) The appliance is in good condition and is fitted with suitable plug.
- (e) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthened metal sheath surrounding the cores.

15.03.00 No electric cable in use by the other Contractor/Employer will be disturbed without permission. No weight of any description will be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it.

15.04.00 No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.

15.05.00 The Contractor shall employ the necessary number of qualified full time electricians to maintain his temporary electrical installation.

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16.00.00 REMOVAL OF MATERIAL

No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.

17.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer 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. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

18.00.00 ACCESS TO SITE AND WORKS ON SITE

18.01.00 Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.

18.02.00 In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.

19.00.00 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The Contractor shall establish an Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

20.00.00 CO-OPERATION WITH OTHER CONTRACTORS

20.01.00 Employer, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer 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 Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his works. Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.

20.02.00 The Employer/Client shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.

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21.00.00 DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer 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 Employer such employee has misconducted himself or is incompetent, negligent or otherwise undesirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

22.00.00 CONTRACTOR'S FIELD OPERATION

22.01.00 The Contractor shall keep the Employer 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 Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer 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.

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

23.00.00 PHOTOGRAPHS AND PROGRESS REPORT

23.01.00 The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.

23.02.00 The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.

23.03.00 The Contractor shall submit the progress of work in CD/DVD (2 copies) quarterly highlighting the progress and constraints at site.

24.00.00 MAN-POWER REPORT

24.01.00 The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.

24.02.00 The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.

25.00.00 PROTECTION OF WORK

The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the

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Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his 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 the as specified at clause no 20.00.00- of this chapter entitled "Co-operation 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 disputes.

26.00.00 EMPLOYMENT OF LABOUR

26.01.00 In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.

26.02.00 All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.

26.03.00 The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.

26.04.00 Contractor's employees shall wear identification badges while on work at Site.

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

27.00.00 NOT USED

28.00.00 FACILITIES TO BE PROVIDED BY THE CONTRACTOR

28.01.00 Contractor's site office Establishment

The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.

28.02.00 Tools, tackles and scaffoldings

The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer 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 Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning.

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28.03.00 **Testing Equipment and Facilities:**

The contractor shall provide the necessary testing, equipment and facilities.

28.04.00 **Site laboratory for civil works:**

Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer.

28.05.00 **First-Aid**

28.05.01 The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.

28.05.02 The Employer will provide the Contractor, in case of any emergency, the services of an ambulance for transportation to the nearest hospital.

28.06.00 **Cleanliness**

28.06.01 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. 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.

28.06.02 Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.

28.07.00 The Contractor shall provide one (1) no. multi-utility vehicle (min. 6 seater) for facilitating movement of Employer's official of the Project, within as well as outside the plant premises. All expenses towards operation and maintenance including provision of drivers, fuel etc. associated with the vehicles shall be borne by the bidder from the date of site office opening till the completion of trial operation of the last unit.

28.08.00 **Electricity**

Refer to construction power, as envisaged in volume-III, Part A, Sec VI of Technical specification.

28.09.00 **Water**

Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony. However, drawl of construction/potable water from bore-well shall be permitted if found suitable. Any statutory clearance required shall be obtained by the contractor. Assistance, if required shall be provided by the owner.

29.00.00 **LINES AND GRADES**

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 Employer at Site at suitable points. These points shall be used as datum for the works under the Contract.

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The Contractor shall inform the Employer 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 Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.

30.00.00 FIRE PROTECTION

30.01.00 The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.

30.02.00 Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

30.03.00 All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.

30.04.00 The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.

31.00.00 SECURITY

The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.

32.00.00 CONTRACTOR'S AREA LIMITS

The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his 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 Employer.

33.00.00 CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on

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the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. 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 installed 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 documents and specifications.

34.00.00 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES

34.01.00 GENERAL

34.01.01 The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/ commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.

34.01.02 The pre-commissioning and commissioning activities including Guarantee/ demonstration/acceptability tests, checks and trial operations of the equipment/ systems furnished and installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at site during such operations.

34.01.03 The following activities shall be carried out by the contractor, at least eight (8) month prior to schedule date of synchronization of 1st Genset.

- (a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer.
- (b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer.
- (c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer.
- (d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.

34.01.04 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.

34.01.05 The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed 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 specifications and documents.

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34.02.00 COMMISSIONING DOCUMENTATION

- 34.02.01 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/ systems covered under the contract, for the approval of employer.
- 34.02.02 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.
- 34.02.03 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example Boiler Feed Pump, condensate pump, compressor etc) Commissioning schedule is a document envisaged for commissioning of a system (for example feed system, Condensate system, Compressed Air system, Fire water system, Unit commissioning etc). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.
- 34.02.04 The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6 (six) month from the date of award of contract, for the acceptance of employer.
- 34.02.05 The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least nine (9) months before the scheduled date of commissioning of the equipment/systems.

34.03.00 COMMISSIONING ACTIVITIES

- 34.03.01 Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.
- 34.03.02 Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.
- 34.03.03 Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.
- 34.03.04 The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.
- 34.03.05 Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.
- 34.03.06 The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.

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34.05.00 **Initial Operation**

Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.

35.00.00 **MATERIALS HANDLING AND STORAGE**

35.01.00 All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.

35.02.00 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer 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 Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

35.03.00 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 Employer.

35.04.00 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 Employer. 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 of such equipment at Site.

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

35.06.00 All the electrical equipment such as motors, generators/alternators, 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 maintained by the Contractor. Such records shall be open for inspection by the Employer.

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

35.08.00 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.

35.09.00 All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.

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

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35.11.00 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, 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.

36.00.00 CONSTRUCTION MANAGEMENT

36.01.00 The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.

36.02.00 The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.

36.03.00 Time is the essence of the Contract and the Contractor shall be responsible for performance of his 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 actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

36.04.00 The Employer 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.

36.05.00 Site management during construction phase till handing over of plant

Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy & unhindered working conditions and a healthy & hygienic working environment at site. He shall ensure the following measures at site while executing the project.

- a) Unhindered motorable road access to all work areas and facilities both during the construction/erection and as they get completed progressively. Required temporary access roads other than the permanent roads shall also be provided. Bidder shall prioritize the construction of approach roads, roads around the main plant block, roads to office & storage areas and the offsite areas from the start of project itself. He shall finalize and submit the complete road layout plan along with priority and completion schedule immediately after the award for review by the Employer .He shall ensure that the roads are promptly repaired and maintained against any damages due to movement of traffic/heavy trailers & cranes etc providing motorable access at all times. Adequate onsite stock of road materials shall be kept and maintained disturbed over the site for repairs especially before the monsoon period.
- b) Proper drainage of rain water, ground water from excavations, water flows from batching plant / construction sites etc. He shall prioritize the construction of permanent drains from the start of the project itself. Till such time the permanent

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drainage network is done, he shall construct adequate temporary drains to ensure that there is no accumulation /stagnation of water in the plant site. Bidder may consider providing pre-cast RCC drains for temporary/ permanent drain construction for faster construction of drains. The drain construction shall be matched with progress of road construction for preventing damage to roads. Bidder shall provide and maintain adequate number of drainage pumps (both electrical and diesel operated) of suitable capacity for pumping out accumulated water especially during the monsoon periods. All drain diversions required shall be undertaken at the start of the project itself.

- c) The plant site is fully secured against unauthorized access.
- d) Proper housekeeping by systematic and proper disposal of earth from excavations (separately for usable & surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing & insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tie-up will also be made for periodic disposal of wastes/ scrap from the designated places.
- e) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platforms. Suitable sheds preferably pre engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum.
- f) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself.
- g) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted.
- h) First aid facilities and amenities like rest rooms, suitable pre engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided.
- i) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also be prioritized along with road

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construction. The construction power ring main shall be planned and erected immediately after the award.

- j) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc.
- k) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis.
- l) Compliance to all safety requirements as specified in this document. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install eight (8) Nos. CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room.
- m) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC (No objection certificate) to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction.
- n) Development of suitable landscape & green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape & green belt areas and rainwater harvesting from the start of the project itself. The landscape and rainwater harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development.
- o) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps.

Bidder shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with Employer. In case the progress on site management plan is unsatisfactory, Employer may withhold up to 1% of the monthly running bill (for civil and site erection works) till such time the required progress is demonstrated. Incase in the opinion of Employer, bidder's actions on site management aspects is not adequate, Employer

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may get the relevant work executed through a separate agency and deduct the expenses incurred from Bidder's bill along with overheads @10 %.

37.00.00 FIELD OFFICE RECORDS

The Contractor shall maintain at his 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 also maintain in addition the continuous record of all changes 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 Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

38.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

38.01.00 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 Employer. All such goods shall, from the time of their being brought vest in the Employer, 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 Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

38.02.00 The Employer shall have a lien on such goods 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 fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off 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.

38.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 38.02.00- of this chapter and credit the proceeds thereto to the account of the Contractor.

39.00.00 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

39.01.00 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 Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

39.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers 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 Employers, related to removal and/or replacement or protection of such property and utilities.

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40.00.00 PAINTING

For painting refer Part-A & B of Section VI of Technical specification.

Painting for structures shall conform to the painting specification specified in Part-B under Civil.

Painting for piping shall conform to the painting specification given in Part-B of the respective chapter.

Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.

41.00.00 INSURANCE

41.01.00 In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.

41.02.00 Workmen's Compensation Insurance

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:

Workmen's Compensation	-	As per Statutory Provisions
Employee's Liability	-	As per Statutory Provisions

41.03.00 Comprehensive Automobile Insurance

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated :

Fatal Injury	:	Rs.100,000 each person
	:	Rs.200,000 each occurrence
Property Damage	:	Rs.100,000 each occurrence

41.04.00 Comprehensive General Liability Insurance

41.04.01 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).

41.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

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

42.00.00 UNFAVORABLE 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 Employer. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

43.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

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 his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

44.00.00 WORK & SAFETY REGULATIONS

44.01.00 General

- i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.
- ii) The Contractor shall follow NVVN Safety Rules as issued from time to time with respect to safety in construction & erection.
- iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.
- iv) The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Annexure - III.
- v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.

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- vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.
- vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.
- viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.
- ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NVVN and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NVVN safety documents as stated above.
- x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.

The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998, their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).
- xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

44.01.01 **Emergency Action Plan**

The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.

44.01.02 **Scaffolding**

The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed

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by a competent person and its erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.

44.01.03 **Opening**

The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.

44.01.04 **Explosives**

The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.

44.02.00 **Fencing of Machinery**

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

44.03.00 **Carrying of Excessive Weight by a Worker**

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.

44.04.00 **Dangerous and Harmful Gases / Equipment**

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

44.05.00 **Overhead Protection**

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

44.06.00 **Working at Heights**

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

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Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.

44.07.00

Handling of Hazardous Chemicals

The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NVVN shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NVVN and NVVN shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NVVN, the Contractor shall use alternative methods with the approval of the NVVN without any cost implication to the NVVN or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All

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precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

44.08.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

44.09.00 **Excavation**

The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

44.10.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.

44.11.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

44.12.00 **Lifting Appliances, Tools & Tackles, Lifting Gear and Pressure Plant & Equipment etc.**

The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting

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equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.

44.13.00 **Excessive Noise, Vibration**

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000.

44.14.00 **Electrical Installations**

44.14.01 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NVVN, he shall

- i) Satisfy the Engineer I/C that the appliance is in good working condition;
- ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;
- iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

- iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NVVN / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.
- v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation.

The installations are provided with suitable ELCBs and RCCBs wherever required.

44.15.00 **Safety Organisation**

44.15.01 The contractor employing more than 250 workmen whether temporary, casual, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NVVN Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub contractor shall also be considered as the contractor's employees/workmen for the above purpose.

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In case of contractor deploying less than 250 workmen he should designate one of his Engr / supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engr./ supervisor should get atleast 2days safety training from any reputed organization or from NVVN before resuming the work. If already trained in past the declaration along with trg. certificate to be furnished to NVVN safety officer.

44.15.02 The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.

44.16.00 **Reporting of Accident and Investigation**

In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NVVN Safety Officer with a copy to NVVN Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.

44.17.00 **Right to stop Work**

44.17.01 The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

44.17.02 The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

44.18.00 **Fire Protection**

The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.

44.19.00 **Penalties**

I If the Contractor fails in providing safe working environment as per the Safety Rules of NVVN or continues the work even after being instructed to stop the work by the Engineer I/C as provided in Clause XVIII (1) above, the Contractor shall be penalized at the rate of Rs. 25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer I/C. However, in case of accident, the provisions contained in Sub-Clause XX (II) below shall also apply in addition to the penalties mentioned in this sub-clause.

II If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or

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employees of other contractors, or NVVN's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to NVVN as per the following schedule:-

a) Fatal injury or accident causing death:

Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less.

b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees:

Penalty @2.5% of contract value or Rs. 1,00,000/- per person which ever is less

Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time.

III If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c / Safety Officer of NVVN shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NVVN will also issue a notice in this regard to the contractor.

IV If two or more fatal accidents occur at same NVVN site under the control of contractor during the period of contract and he has

- (1) not complied with keeping adequate PPEs in stock or
- (2) defaulted in providing PPEs to his workmen
- (3) not followed statutory requirements / NVVN safety rules
- (4) been issued warning notice/s by NVVN head of the project on non observance of safety norms
- (5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NVVN for two years from the date of last accident.

The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NVVN. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.

44.20.00

The Contractor will make available minimum quantity of all safety equipments and safety PPEs of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availability of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.

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44.21.00 The Contractor shall abide by the following during Construction and Erection activities:

- I. Chain pulley block shall not be used for loads more than 2 (Two) tonne.
- II. Hydra shall not be used for material transport.
- III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m.
- IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.

44.21.00 **Award**

If the Contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme of the employer.

45.00.00 FOREIGN PERSONNEL

45.01.00 The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.

45.02.00 Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.

45.03.00 No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.

45.04.00 The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.

45.05.00 The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time or full-time nor shall they take part in any local politics.

45.06.00 The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.

46.00.00 FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES

46.01.00 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.

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46.02.00 All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.

46.03.00 The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.

46.04.00 **Grout**

The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm² at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer.

The Grout shall have good flowability even at very low water/ grout powder ratio.

The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use.

The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.

46.05.00 **Placing of Grout**

46.05.01 After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.

46.05.02 The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.

46.05.03 In addition to the above, recommendations of Grout manufacturer shall also be followed.

46.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

46.07.00 **Checking of Equipment after Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the

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like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check-up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.

47.00.00 SHAFT ALIGNMENTS

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

48.00.00 DOWELLING

All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

49.00.00 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

50.00.00 COMMISSIONING SPARES

50.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within thirty (30) days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

50.02.00 These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

51.00.00 CABLING

51.01.00 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.

51.02.00 Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

51.03.00 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation

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of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

- 51.04.00 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.
- 51.05.00 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.
- 51.06.00 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

52.00.00 EQUIPMENT DELIVERY AND ERECTION

52.01.00 General Requirements

- (a.) This part covers Contractor's responsibilities for packing, shipping, ware-housing and the installation of all equipment and materials furnished and installed under this specification.
- (b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following:
- (1.) Instructions for packing, shipping, receiving handling, ware-housing and storage.
 - (2.) Instructions for location and installation of equipment furnished by this specification.
 - (3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.
 - (4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.
 - (5.) Check lists and quality assurance hold points.
 - (6.) Format for all related documentation.
- (c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and

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accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

- (d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engineering.

52.02.00

Crating

- (a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.
- (b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.
- (c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping.
- (d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.
- (e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.
- (f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.
- (g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number:
- a) Export case markings
 - b) Case number
 - c) Gross weight and net weight in Kilograms
 - d) Dimensions in centimeters
 - e) Complete description of material
- (h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be

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considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

- (i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.
- (j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.
- (k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.
- (l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.
- (m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.
- (n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.
- (o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.

52.03.00

Factory Assembly

- (a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.
- (b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

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52.04.00

Equipment Installation

(a.) General Requirements

- (1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.
- (2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.
- (3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.
- (4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.

(b.) Installation Materials

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

(c.) Regulatory Requirements

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

(d.) Cleaning

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

(e.) Equipment Assembly

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.

(f.) Equipment Setting

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.

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(g.) Free-Standing Equipment

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

(h.) Non-free Standing Equipment

- (1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.
- (2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.

(i.) Equipment Location

- (1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.
- (2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.
- (3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.
- (4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.
- (5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.
- (6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred.

(j.) Installation of Field Mounted Instruments and Devices

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

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In addition to above relevant Portion as specified elsewhere in technical specification may be referred.

(k.) **Piping Connections**

- (1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.
- (2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

(l.) **Equipment Checkout**

- (1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.
- (2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

(m.) **Defects**

- (1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.
- (2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

(n.) **Equipment Protection**

- (1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.
- (2.) The equipment shall be protected during storage as described herein.
- (3.) Equipment shall be protected from weld spatter during construction.
- (4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.
- (5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.
- (6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be

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provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

53.00.00 WELDING - SPECIAL REQUIREMENTS

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

54.00.00 DEVIATIONS DISPOSITIONING:

Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NVVN. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.

55.00.00 NON-DESTRUCTIVE TESTING (NDT):

The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed.

56.00.00 TESTING EQUIPMENT & FACILITIES:

Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.

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ANNEXURE-I

STANDARD CHECKLIST

COMMISSIONING/TESTING ESSENTIAL PRE-REQUISITE

1. MECHANICAL

(A.) VALVES

- (1.) MANUALLY OPERATED VALVE
- (2.) ELECTRICALLY OPERATED VALVE
- (3.) PNEUMATICALLY ACTUATED VALVE
- (4.) HYDRAULICALLY ACTUATED VALVE
- (5.) SAFETY VALVE
- (6.) ELECTROMATIC RELIEF VALVE
- (7.) BUTTERFLY VALVE (ELECTRICALLY OPERATED)
- (8.) BUTTERFLY VALVE (MANUALLY OPERATED)
- (9.) BUTTERFLY VALVE (FOUR WAY-ELECTRICAL)
- (10.) NON-RETURN VALVE (INCLUDING HYDRAULIC/PNEUMATIC FCNRVS)
- (11.) THREE WAY CONTROL VALVE
- (12.) RELIEF VALVE
- (13.) DIFFERENTIAL PRESSURE REGULATING VALVE
- (14.) FLOAT OPERATED VALVES

(B.) TANKS AND PRESSURE VESSELS

- (1.) TANKS (METAL) UPTO 20 M²
- (2.) TANKS (LARGE STORAGE)
- (3.) PRESSURE VESSEL (BELOW 17 BARS)
- (4.) AIR RECEIVER

(C.) PUMPS

- (1.) PUMP LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN)
- (2.) PUMP UP TO 350 HP (260 KW)
- (3.) PUMP SUMP INSTALLATION

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- (4.) GEAR PUMP/SCREW PUMP
- (D.) PIPE WORK SYSTEM
 - (1.) WATER SERVICES
 - (2.) OIL/FIRE RESISTANT FLUID SYSTEM
 - (3.) AIR SERVICES (COMPRESSOR)
 - (4.) HIGH PRESSURE SERVICES
 - (5.) CONSTANT LOAD SUPPORT
 - (6.) SPRING SUPPORTS
 - (7.) HANGERS AND OTHER SUPPORTS
- (E.) STRAINER AND FILTER
 - (1.) STRAINER/FILTER BASKET TYPE
 - (2.) STRAINER ROTARY (LOW PRESSURE)
 - (3.) FILTER & STRAINERS CENTRIFUGAL SEPARATORS
 - (4.) FILTER & STRAINER Y-TYPE
 - (5.) FILTER & STRAINER (PLATE TYPE)
 - (6.) PURIFIER
 - (7.) FILTER-COMPRESSED AIR LINE
- (F.) HEAT EXCHANGER
 - (1.) HEAT EXCHANGER (GENERAL)
 - (2.) HEAT EXCHANGER-OIL/WATER
- (G.) FANS AND COMPRESSORS
 - (1.) FANS-NON-PRESSURE LUBRICATED
 - (2.) FANS-AXIAL FLOW PRESSURE LUBRICATED
 - (3.) COMPRESSORS-GENERAL
 - (4.) DAMPERS & GATES
- (H.) CRANES AND ELEVATORS
 - (1.) AUXILIARY OVERHEAD CRANE
 - (2.) TRAVEL SUPPORT STRUCTURE FOR CRANE

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- (3.) LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE
- (4.) MAIN AUX. HOIST MOTION (CRANE)
- (5.) ELECTRIC HOIST
- (I.) POWER TRANSMISSION
 - (1.) POWER TRANSMISSION GEAR BOX
 - (2.) BEARING
 - (3.) FLUID COUPLINGS

2. ELECTRICAL

- (1.) SWITCHYARD
- (2.) POWER TRANSFORMERS, LT INDOOR TRANSFORMERS, OUTDOOR TRANSFORMERS,
- (3.) BATTERY CHARGERS, DC BATTERIES, DG SETS, STATION LIGHTING, OVERHEAD LINES.
- (4.) MV BUS DUCTS
- (5.) D.C. MOTOR
- (6.) HV SQUIRREL CAGE INDUCTION MOTOR
- (7.) 415 V SQUIRREL CAGE INDUCTION MOTOR
- (8.) MOTOR OPERATED ACTUATORS
- (9.) LT SWITCHGEARS/MCC
 - (I.) STANDARD CHECKLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM
 - (II.) PT CARRIAGE AND CUBICLES
 - (III.) CABLE/BUS DUCT/BUS BARS
 - (IV.) CONTRACTOR MODULE
 - (V.) SWITCH FUSE MODULE
 - (VI.) MASTER PANEL OF LUBE OIL PANEL
 - (VII.) FEEDER PANEL OF LUBE OIL PANEL
 - (VIII.) SPACE HEATER AND CABLE MODULE
 - (IX.) CONTROL TRANSFORMER MODULE
 - (X.) HT CIRCUIT BREAKER

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- (XI.) 415 V CIRCUIT BREAKER
- (10.) POWER CABLE
- (11.) CONTROL CABLE
- (12.) AUXILIARY CABLE
- (13.) D.C. CABLE
- (14.) EXPLOSION PROOF ELECTRICAL EQUIPMENT
- (15.) JUNCTION BOX
- (16.) CONTROL TRANSFORMER MODULE
- (17.) BRUSH GEAR ASSEMBLY
- (18.) AUX. CONTROL AND RELAY PANEL DESK
- (19.) INDICATING INSTRUMENT
- (20.) RECORDING INSTRUMENT
- (21.) INTEGRATING INSTRUMENT

3. CONTROL & INSTRUMENTATION

- (A.) CONDUCTIVITY ANALYSING EQUIPMENT INCLUDING TEST PROCEDURES
- (B.) PH ANALYSER INCLUDING TEST PROCEDURE
- (C.) SILICA ANALYSER
- (D.) LEVEL SWITCH (FLOAT ACTUATED)
- (E.) LEVEL SWITCH (ELECTRODE TYPE)
- (F.) LEVEL SWITCH (DISPLACER ACTUATED)
- (G.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURE
- (H.) LEVEL INDICATOR (FLOAT/PULLEY TYPE)
- (I.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE
- (J.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE
- (K.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE
- (L.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/TRANSMITTER INCLUDING TEST PROCEDURES.

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- (M.) TEMPERATURE SWITCH/THERMOSTAT INCLUDING TEST PROCEDURES
- (N.) COLD JUNCTION BOXES
- (O.) ZENER BARRIER
- (P.) O₂ ANALYSER
- (Q.) O₂ IN HYDROGEN INCLUDING TEST PROCEDURES
- (R.) PRESSURE AND VACUUM GAUGE
- (S.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE
- (T.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE
- (U.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE.
- (V.) FLOW INDICATOR (VARIABLE AREA)
- (W.) ORIFICE PLATE
- (X.) TURBINE FLOW TRANSMITTER
 - (I.) FLOW SWITCH
 - (II.) WEIR
 - (III.) NOZZLE
 - (IV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE
 - (V.) FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TESTPROCEDURE
 - (VI.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE
 - (VII.) VENTURI (FLUID)
 - (VIII.) FLOW SWITCH (MAGNETIC TYPE)
 - (IX.) AVERAGING INLET
 - (X.) LIMIT SWITCHES
- (Y.) TURBINE SUPERVISORY MEASURING SYSTEM
- (Z.) POSITION MEASUREMENT AND INDICATION INCLUDING TEST PROCEDURES
- (AA.) TACHOMETER
- (BB.) VIBRATION MEASUREMENT

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- (CC.) DIGITAL INDICATOR
- (DD.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE
- (EE.) RECORDER INCLUDING TEST PROCEDURE
- (FF.) FLAME SCANNER
- (GG.) ELECTRICAL AUTO MANUAL CONTROL STATION
- (HH.) PUSH BUTTON MODULE
- (II.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PRO
- (JJ.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS
- (KK.) THERMO CONTROL VALVE
- (LL.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER - PID TERMS
- (MM.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT AND PNEUMATIC OUTPUT

Note: The items which are not part of this specification may be considered as not applicable.

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ANNEXURE-II

BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE

Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.

Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.

Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self contained one:

1. Plant Details/Design data
2. Testing Objective/Proposals
3. State of the Plant
 - a) Erection Status with respect to Mech. Elect and C&I
 - b) Availability of the services required
 - c) Safety requirements as per Manufacturer's
4. Test method including completion/acceptance criteria
5. Results
6. Appendix
 - a) Testing Programme
 - b) Mech./Elect./C&I -Plant item completing list
 - c) List of Drawing/documents required for carrying out the testing.

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ANNEXURE - III

SAFETY PLAN

01. Safety Policy of the Contractor to be enclosed.
02. When was the Safety Policy last reviewed.
03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules.
04. Name, Qualification, experience of Safety Officer
05. Review of Accidents Analysis Method, Methods to ensure Safety and Health.
06. Unit executive responsible to ensure Safety at various levels in work area.
07. List of employees trained in safety employed before execution of the job. Give the details of training.
08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees.
09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed).
10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed.
11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity.
12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up.
13. Provision for treatment of injured persons at work site.
14. Review of overall safety by top Management and Periodicity.
15. System for Implementation of Statutory legislations.
16. Issue of PPEs to employees, Periodicity / stock on hand etc.

Signature
Head of the Organisation
with date & stamp

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